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Lebanese American University

Center for Innovative Learning

Fostering Active Learning: Using Interactive Tools to Enhance Engagement and Participation

CIE 202 (Mechanics of Materials) – Spring 2025

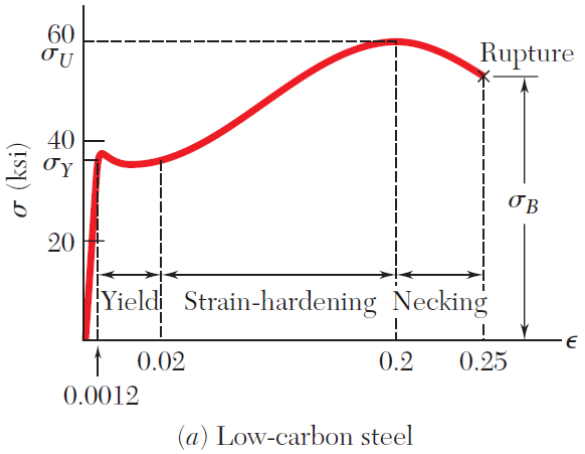
April 22, 2025

Hamza Jaffal

Course Description

CIE 202: Mechanics of Materials – Spring 2025

- Required course for **Civil, Mechanical,** and **Petroleum Engineering**
- Registered by **first** and **second year** students
- Spring 2025 section consisted of **7 students**



(*a*) Low-carbon steel

Beer et al. (2009). Statics and Mechanics of Materials

Design

Golden Gate Bridge, California – June 2023

Learning Outcomes

Course Learning Outcomes:

1. **Calculate** stresses and strains in axially loaded members.
2. **Analyze** statically indeterminate structures.
3. **Apply** stress transformation to find stresses at different orientations.
4. **Estimate** deflections of beams and shafts by integration.
5. **Design** members subjected to axial load, bending moment, torsion, and shear.

Course Outline

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Outline:		***Activities:***
1. Statics Review		
2. Concepts of Stress	------→	• Padlet Poll
3. Stress and Strain – Axial Loading	------→	• Flipped Classroom - 1
4. Torsion	------→	• Padlet Poll
5. Pure Bending	------→	• Padlet Poll
6. Shearing Stresses in Beams and Thin-Walled Members	------→	• Padlet Poll
7. Transformation of Stresses	------→	• Flipped Classroom – 2
8. Deflection of Beams	------→	• Padlet Poll

Grade Distribution

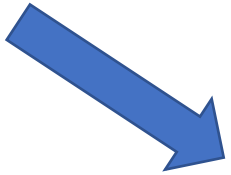
Old

Homework/Participation	10%
Exams 1, 2, and 3	50%
Final Exam	40 %

Grade Distribution

Old

Homework/Participation	10%
Exams 1, 2, and 3	50%
Final Exam	40 %



New

Homework	5%
Participation	5%
Exams 1, 2, and 3	50%
Final Exam	40 %

Grade Distribution

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Old

Homework/Participation	10%
Exams 1, 2, and 3	50%
Final Exam	40 %

Course outline:		***Activities:***
1. Statics Review		
2. Concepts of Stress	Chapter 8	• Padlet Poll
3. Stress and Strain – Axial Loading	Chapter 9	• Flipped Classroom - 1
4. Torsion	Chapter 10	• Padlet Poll
5. Pure Bending	Chapters 11,12	• Padlet Poll
6. Shearing Stresses in Beams and Thin-Walled Members	Chapter 13	• Padlet Poll
7. Transformation of Stresses	Chapter 14	• Flipped Classroom – 2
8. Deflection of Beams	Chapter 15	• Padlet Poll

New

Homework	5%
Participation	5%
Exams 1, 2, and 3	50%
Final Exam	40 %

For more interactive learning

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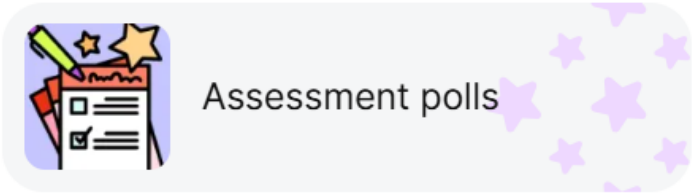
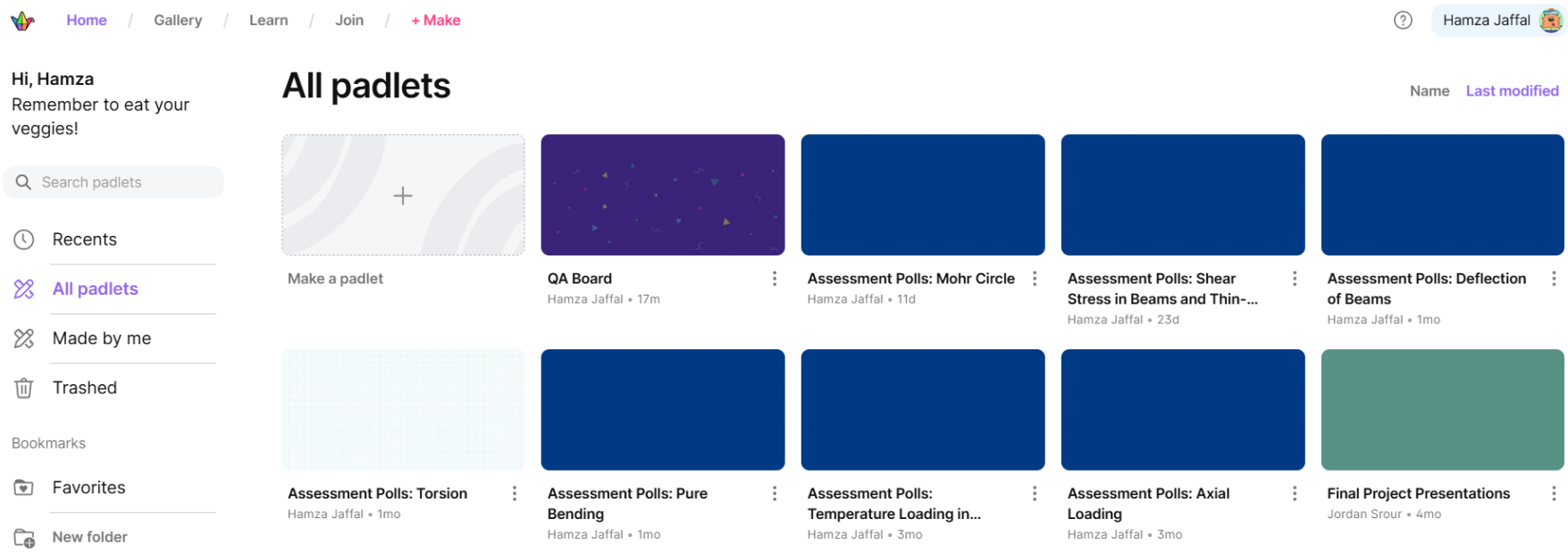
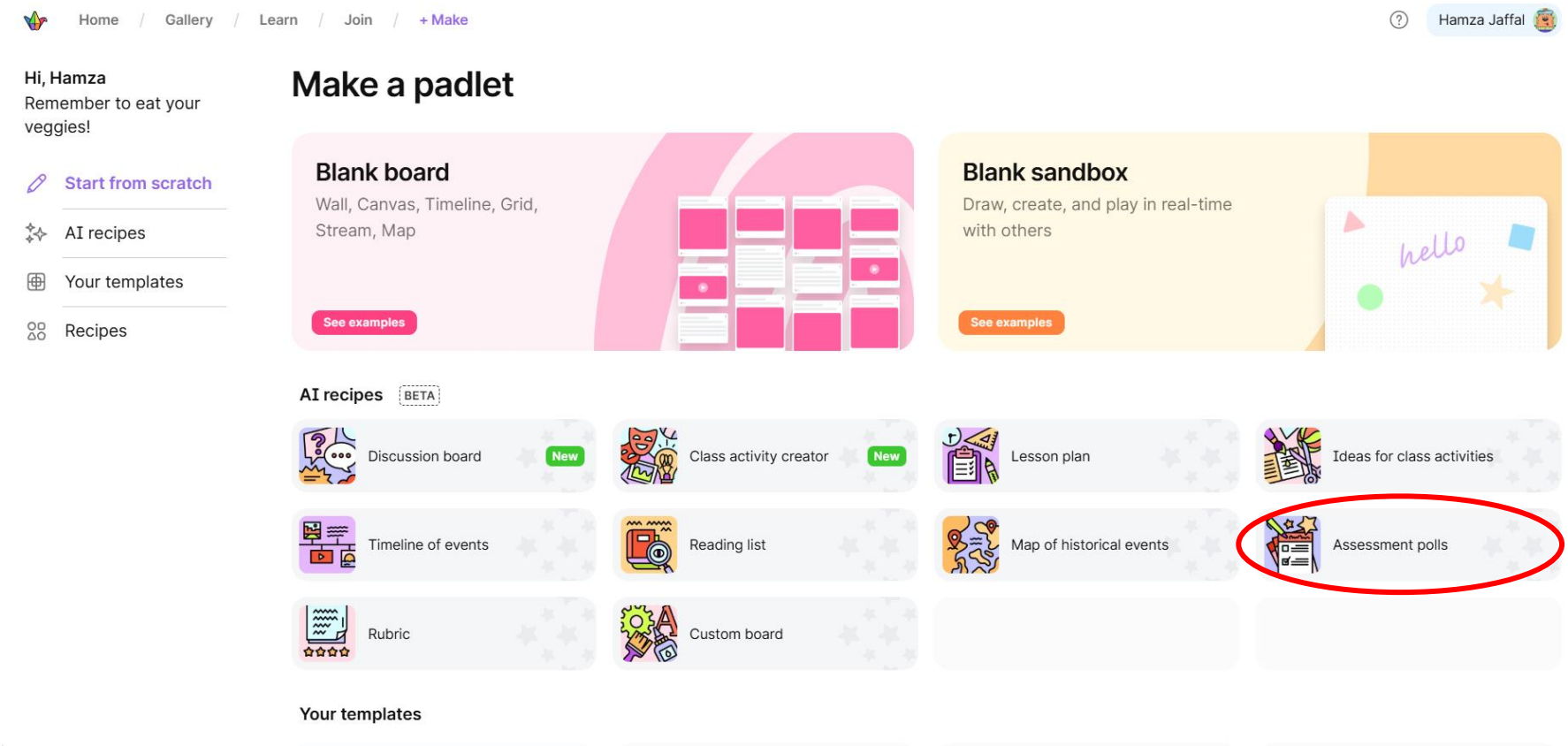
padlet



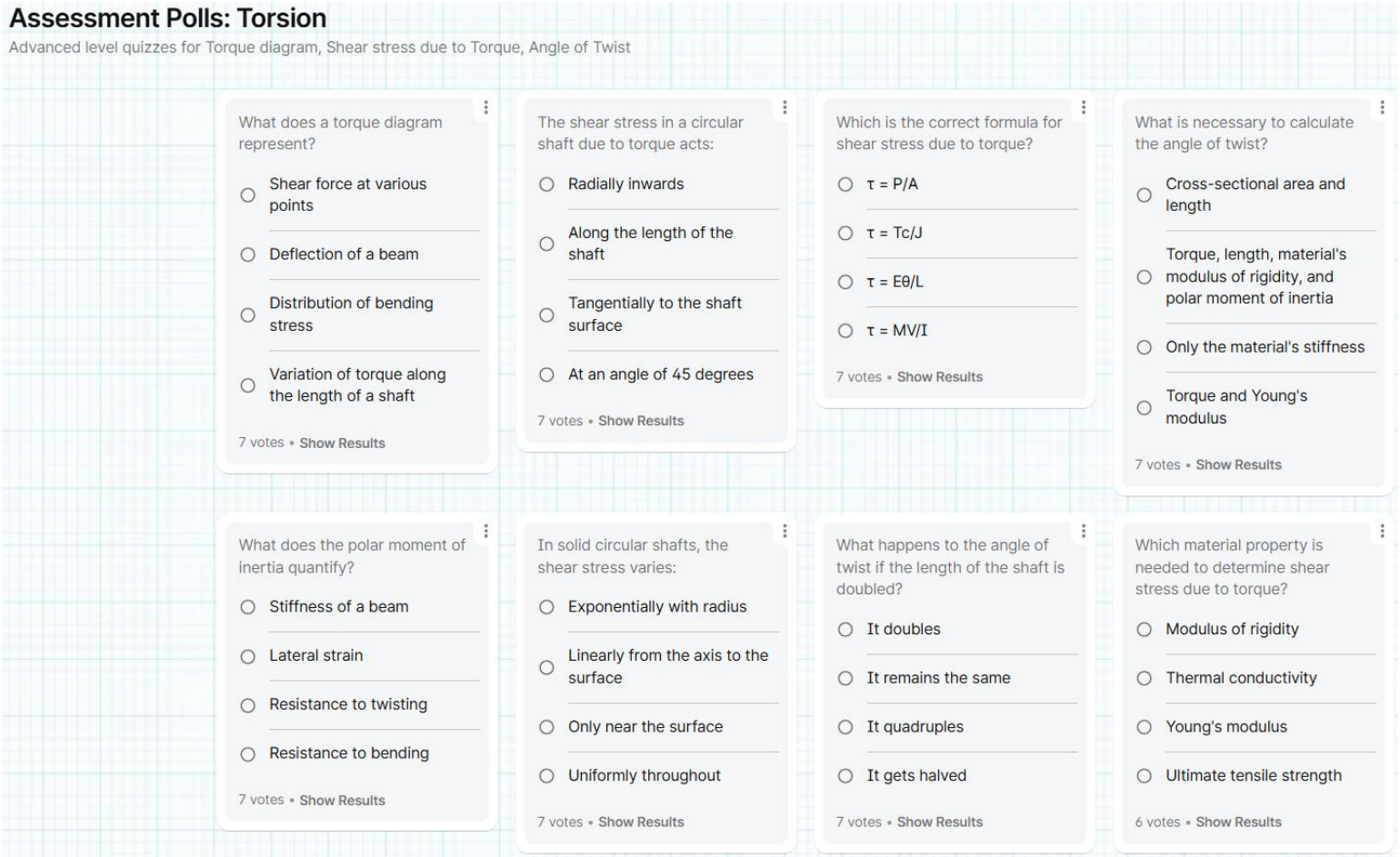
Poll


Home / Gallery / Learn / Join / + Make
Hamza Jaffal
Hi, Hamza
Remember to eat your veggies!
Search padlets
Recents
All padlets
Made by me
Trashed
Bookmarks
Favorites
New folder
All padlets
Name Last modified
Make a padlet
QA Board
Hamza Jaffal • 17m
Assessment Polls: Mohr Circle
Hamza Jaffal • 11d
Assessment Polls: Shear Stress in Beams and Thin-...
Hamza Jaffal • 23d
Assessment Polls: Deflection of Beams
Hamza Jaffal • 1mo
Assessment Polls: Torsion
Hamza Jaffal • 1mo
Assessment Polls: Pure Bending
Hamza Jaffal • 1mo
Assessment Polls: Temperature Loading in...
Hamza Jaffal • 3mo
Assessment Polls: Axial Loading
Hamza Jaffal • 3mo
Final Project Presentations
Jordan Srour • 4mo

Poll

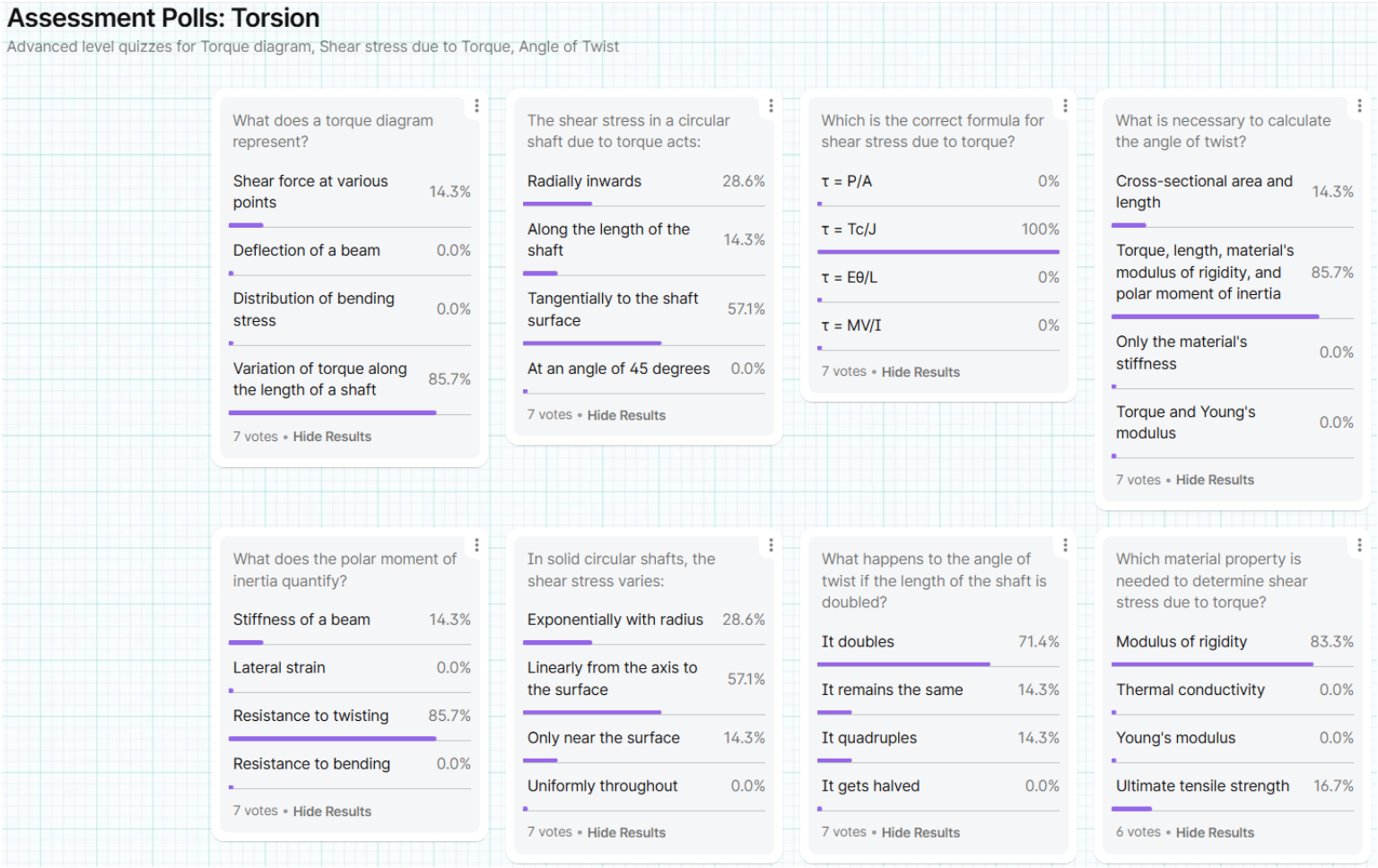

Home / Gallery / Learn / Join / + Make
Hamza Jaffal
Hi, Hamza
Remember to eat your veggies!
Start from scratch
AI recipes
Your templates
Recipes
Make a padlet
Blank board
Wall, Canvas, Timeline, Grid, Stream, Map
See examples
Blank sandbox
Draw, create, and play in real-time with others
See examples
hello
AI recipes BETA
Discussion board New
Class activity creator New
Lesson plan
Ideas for class activities
Timeline of events
Reading list
Map of historical events
Assessment polls
Rubric
Custom board
Your templates

Poll


Assessment Polls: Torsion
Advanced level quizzes for Torque diagram, Shear stress due to Torque, Angle of Twist
What does a torque diagram represent?
Shear force at various points
Deflection of a beam
Distribution of bending stress
Variation of torque along the length of a shaft
7 votes • Show Results
The shear stress in a circular shaft due to torque acts:
Radially inwards
Along the length of the shaft
Tangentially to the shaft surface
At an angle of 45 degrees
7 votes • Show Results
Which is the correct formula for shear stress due to torque?
τ = P/A
τ = Tc/J
τ = Eθ/L
τ = MV/I
7 votes • Show Results
What is necessary to calculate the angle of twist?
Cross-sectional area and length
Torque, length, material's modulus of rigidity, and polar moment of inertia
Only the material's stiffness
Torque and Young's modulus
7 votes • Show Results
What does the polar moment of inertia quantify?
Stiffness of a beam
Lateral strain
Resistance to twisting
Resistance to bending
7 votes • Show Results
In solid circular shafts, the shear stress varies:
Exponentially with radius
Linearly from the axis to the surface
Only near the surface
Uniformly throughout
7 votes • Show Results
What happens to the angle of twist if the length of the shaft is doubled?
It doubles
It remains the same
It quadruples
It gets halved
7 votes • Show Results
Which material property is needed to determine shear stress due to torque?
Modulus of rigidity
Thermal conductivity
Young's modulus
Ultimate tensile strength
6 votes • Show Results

Poll

Poll

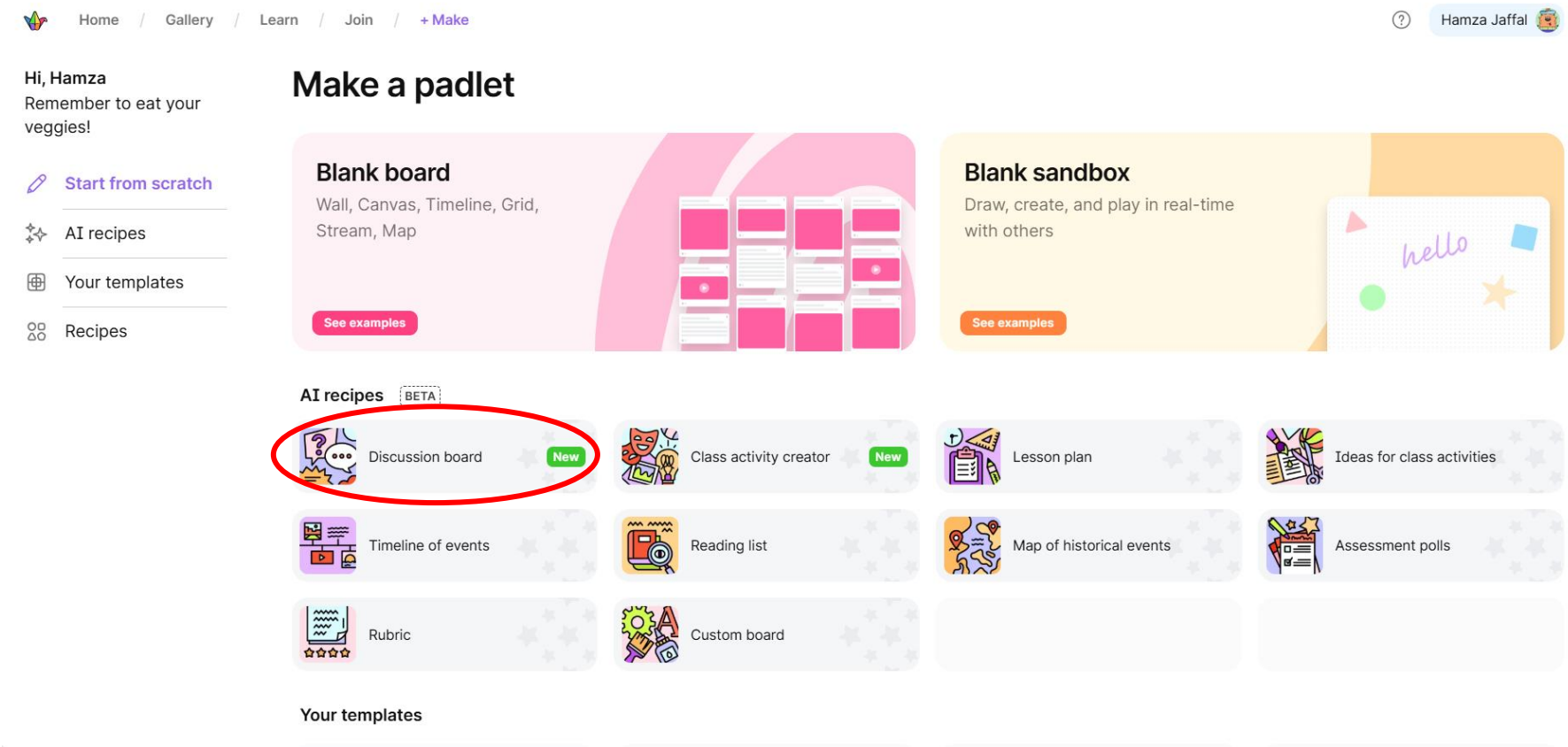

Assessment Polls: Torsion
Advanced level quizzes for Torque diagram, Shear stress due to Torque, Angle of Twist
What does a torque diagram represent?
Shear force at various points 14.3%
Deflection of a beam 0.0%
Distribution of bending stress 0.0%
Variation of torque along the length of a shaft 85.7%
7 votes • Hide Results
The shear stress in a circular shaft due to torque acts:
Radially inwards 28.6%
Along the length of the shaft 14.3%
Tangentially to the shaft surface 57.1%
At an angle of 45 degrees 0.0%
7 votes • Hide Results
Which is the correct formula for shear stress due to torque?
τ = P/A 0%
τ = Tc/J 100%
τ = Eθ/L 0%
τ = MV/I 0%
7 votes • Hide Results
What is necessary to calculate the angle of twist?
Cross-sectional area and length 14.3%
Torque, length, material's modulus of rigidity, and polar moment of inertia 85.7%
Only the material's stiffness 0.0%
Torque and Young's modulus 0.0%
7 votes • Hide Results
What does the polar moment of inertia quantify?
Stiffness of a beam 14.3%
Lateral strain 0.0%
Resistance to twisting 85.7%
Resistance to bending 0.0%
7 votes • Hide Results
In solid circular shafts, the shear stress varies:
Exponentially with radius 28.6%
Linearly from the axis to the surface 57.1%
Only near the surface 14.3%
Uniformly throughout 0.0%
7 votes • Hide Results
What happens to the angle of twist if the length of the shaft is doubled?
It doubles 71.4%
It remains the same 14.3%
It quadruples 14.3%
It gets halved 0.0%
7 votes • Hide Results
Which material property is needed to determine shear stress due to torque?
Modulus of rigidity 83.3%
Thermal conductivity 0.0%
Young's modulus 0.0%
Ultimate tensile strength 16.7%
6 votes • Hide Results

Poll

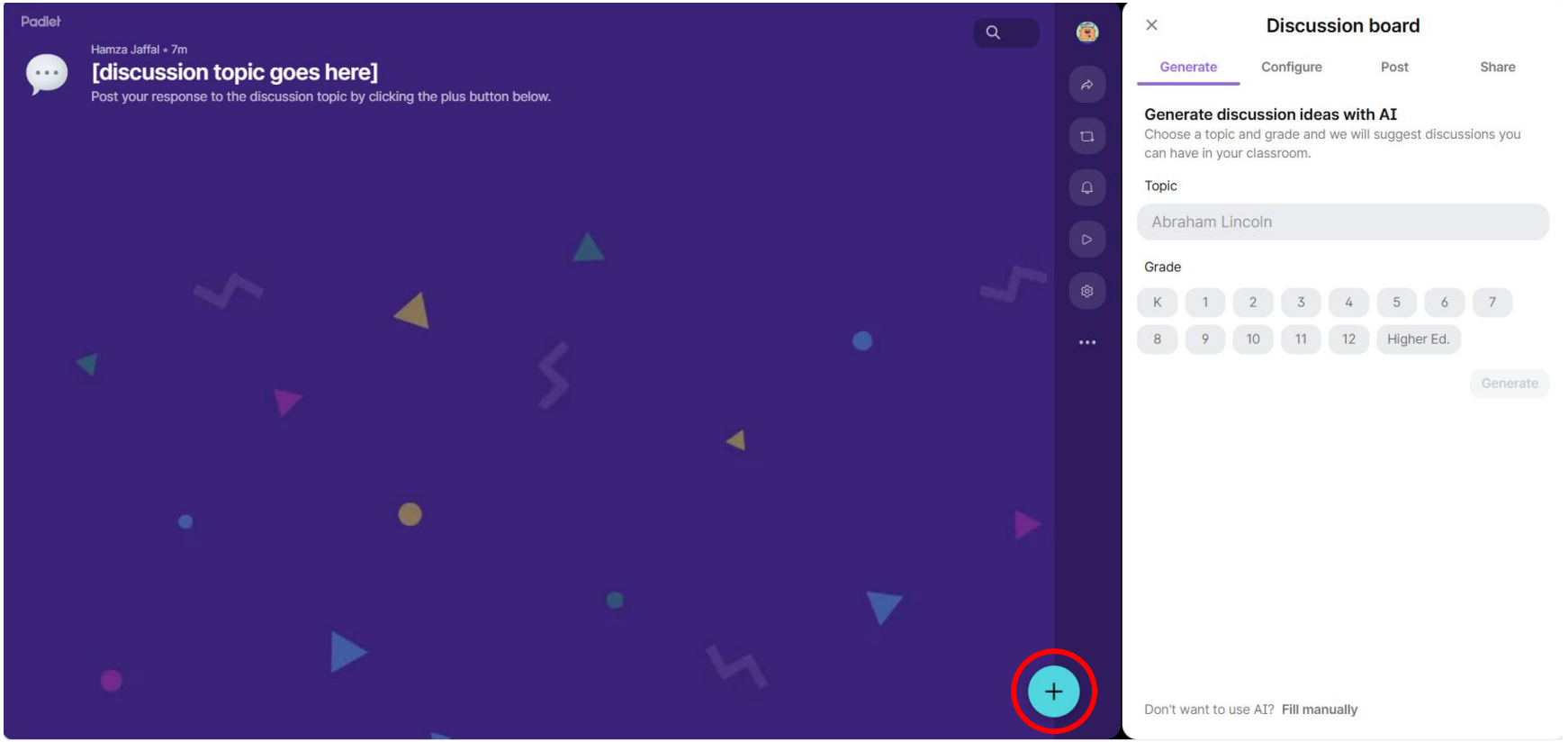
Creating a Poll using AI assistant

Blackboard

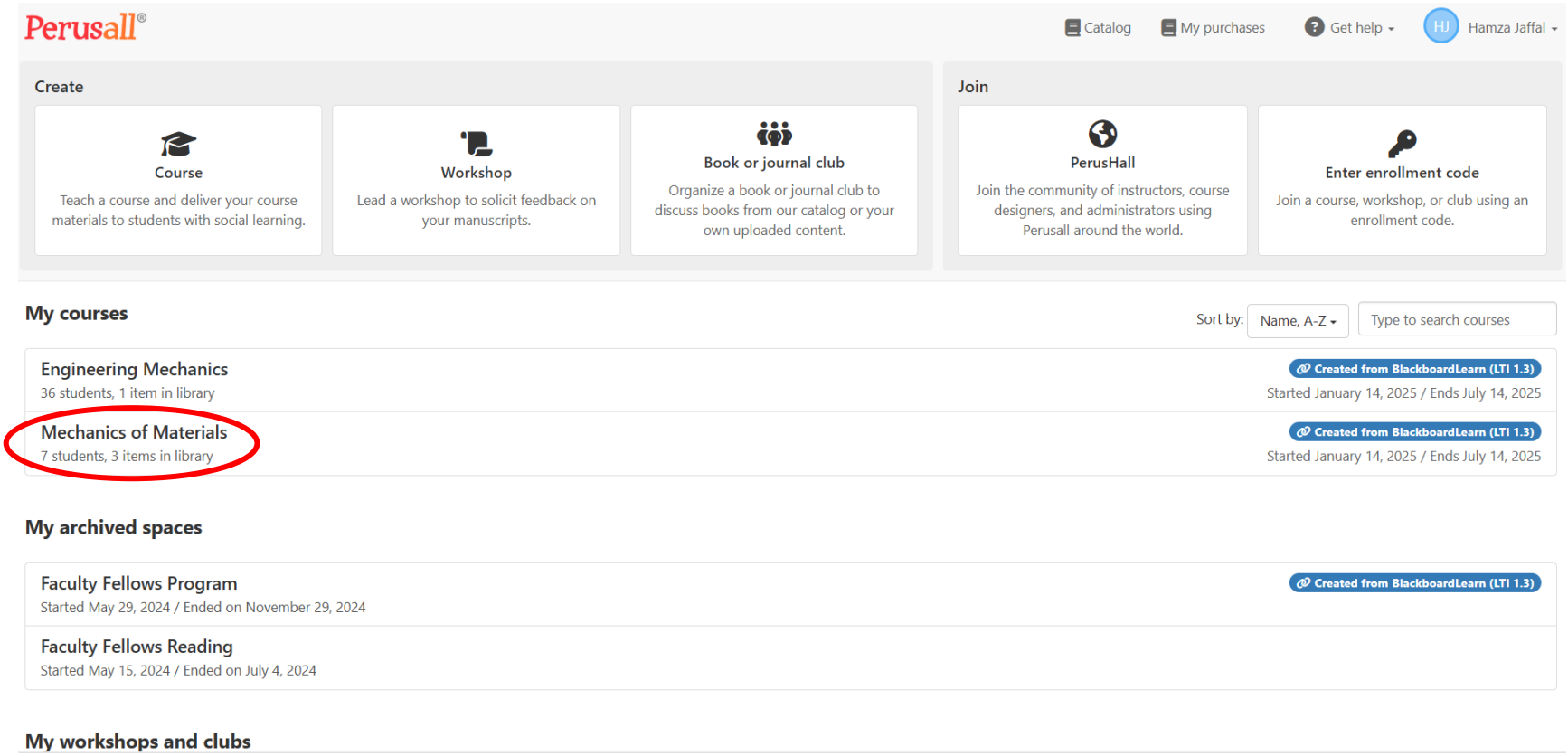
Discussion Board



Discussion Board



Course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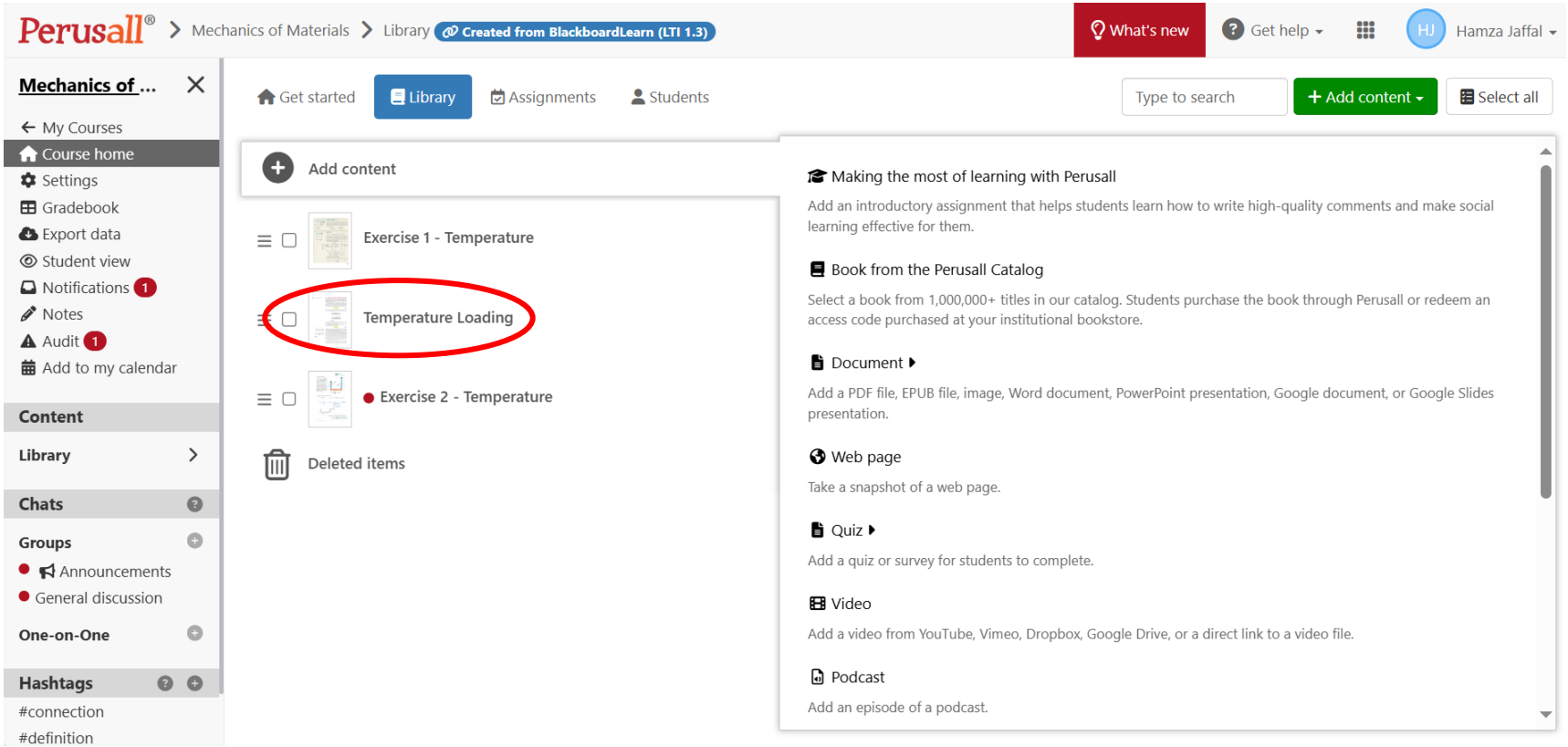
HJ
Hamza Jaffal
Create
Course
Teach a course and deliver your course materials to students with social learning.
Workshop
Lead a workshop to solicit feedback on your manuscripts.
Book or journal club
Organize a book or journal club to discuss books from our catalog or your own uploaded content.
Join
PerusHall
Join the community of instructors, course designers, and administrators using Perusall around the world.
Enter enrollment code
Join a course, workshop, or club using an enrollment code.
My courses
Sort by:
Name, A-Z
Type to search courses
Engineering Mechanics
36 students, 1 item in library
Created from BlackboardLearn (LTI 1.3)
Started January 14, 2025 / Ends July 14, 2025
Mechanics of Materials
7 students, 3 items in library
Created from BlackboardLearn (LTI 1.3)
Started January 14, 2025 / Ends July 14, 2025
My archived spaces
Faculty Fellows Program
Started May 29, 2024 / Ended on November 29, 2024
Created from BlackboardLearn (LTI 1.3)
Faculty Fellows Reading
Started May 15, 2024 / Ended on July 4, 2024
My workshops and clubs

Document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What's new
Get help
HJ
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Mechanics of ...
My Courses
Course home
Settings
Gradebook
Export data
Student view
Notifications 1
Notes
Audit 1
Add to my calendar
Content
Library
Chats
Groups
Announcements
General discussion
One-on-One
Hashtags
#connection
#definition
Get started
Library
Assignments
Students
Type to search
Add content
Select all
Add content
Exercise 1 - Temperature
Temperature Loading
Exercise 2 - Temperature
Deleted items
Making the most of learning with Perusall
Add an introductory assignment that helps students learn how to write high-quality comments and make social learning effective for them.
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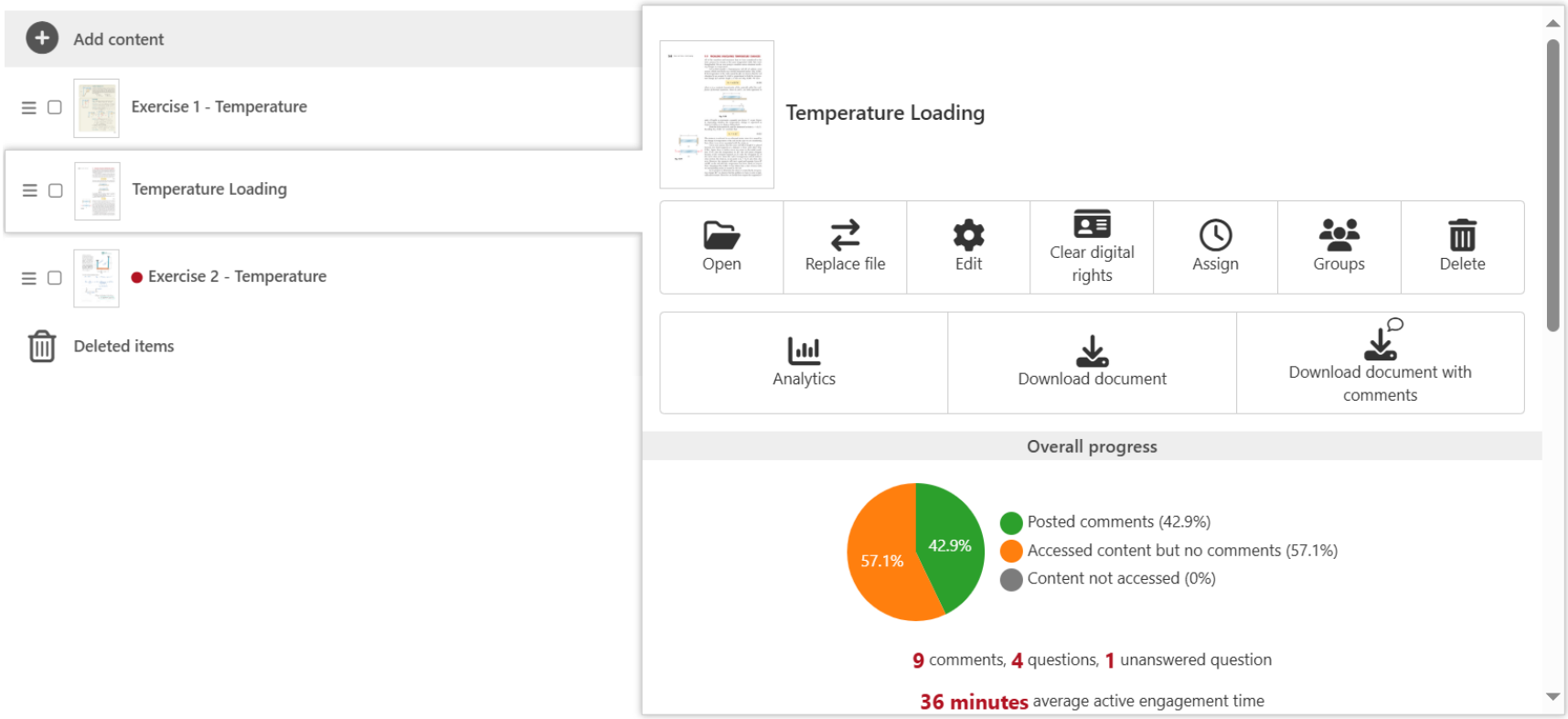
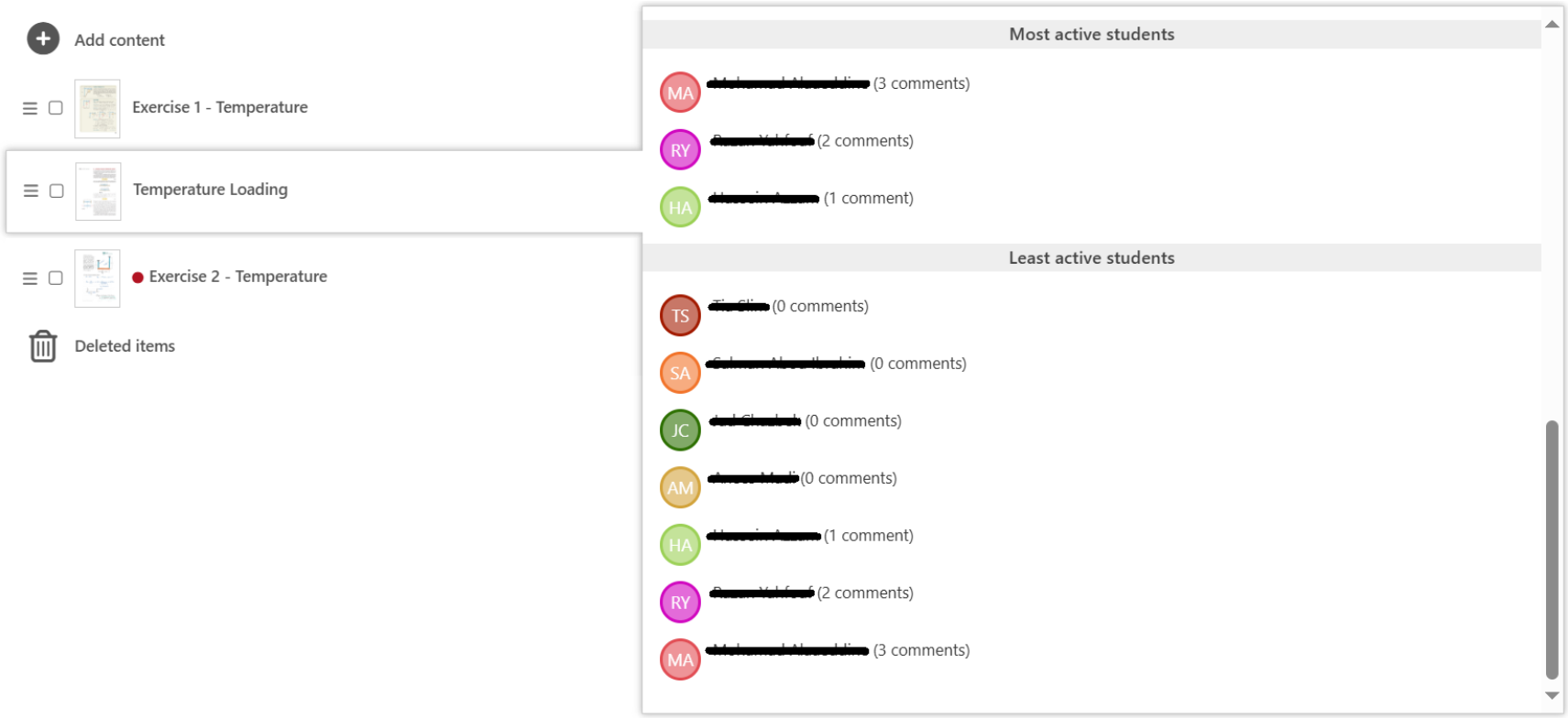
Select a book from 1,000,000+ titles in our catalog. Students purchase the book through Perusall or redeem an access code purchased at your institutional bookstore.
Document
Add a PDF file, EPUB file, image, Word document, PowerPoint presentation, Google document, or Google Slides presentation.
Web page
Take a snapshot of a web page.
Quiz
Add a quiz or survey for students to complete.
Video
Add a video from YouTube, Vimeo, Dropbox, Google Drive, or a direct link to a video file.
Podcast
Add an episode of a podcast.

Tracking


Add content
Exercise 1 - Temperature
Temperature Loading
Exercise 2 - Temperature
Deleted items
Temperature Loading
Open
Replace file
Edit
Clear digital rights
Assign
Groups
Delete
Analytics
Download document
Download document with comments
Overall progress
57.1%
42.9%
Posted comments (42.9%)
Accessed content but no comments (57.1%)
Content not accessed (0%)
9 comments, 4 questions, 1 unanswered question
36 minutes average active engagement time

Tracking


Add content
Exercise 1 - Temperature
Temperature Loading
Exercise 2 - Temperature
Deleted items
Most active students
MA [redacted] (3 comments)
RY [redacted] (2 comments)
HA [redacted] (1 comment)
Least active students
TS [redacted] (0 comments)
SA [redacted] (0 comments)
JC [redacted] (0 comments)
AM [redacted] (0 comments)
HA [redacted] (1 comment)
RY [redacted] (2 comments)
MA [redacted] (3 comments)

Activities:

1 – Temperature Loading:

- Perusal reading
- Padlet poll
- In-class group activity

2 – Stress Transformation:

- Study of a slide
- Padlet discussion board
- Excel sheet demo
- Padlet poll
- In-class group activity

Activities:

1 – Temperature Loading:

- Perusal reading
- Padlet poll
- In-class group activity

2 – Stress Transformation:

- Study of a slide
- Padlet discussion board
- Excel sheet demo
- Padlet poll
- In-class group activity

1 – Temperature Loading

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368 Stress and Strain—Axial Loading

9.9 PROBLEMS INVOLVING TEMPERATURE CHANGES

All of the members and structures that we have considered so far were assumed to remain at the same temperature while they were being loaded. We are now going to consider various situations involving changes in temperature.

Let us first consider a homogeneous rod AB of uniform cross section, which rests freely on a smooth horizontal surface (Fig. 9.28*a*). If the temperature of the rod is raised by ΔT, we observe that the rod elongates by an amount δ_T which is proportional to both the temperature change ΔT and the length L of the rod (Fig. 9.28*b*). We have

$$\delta_T = \alpha(\Delta T)L \tag{9.20}$$

where α is a constant characteristic of the material, called the *coefficient of thermal expansion*. Since δ_T and L are both expressed in

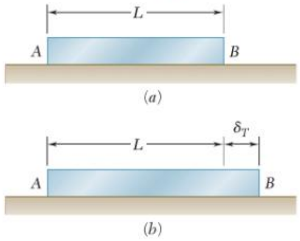
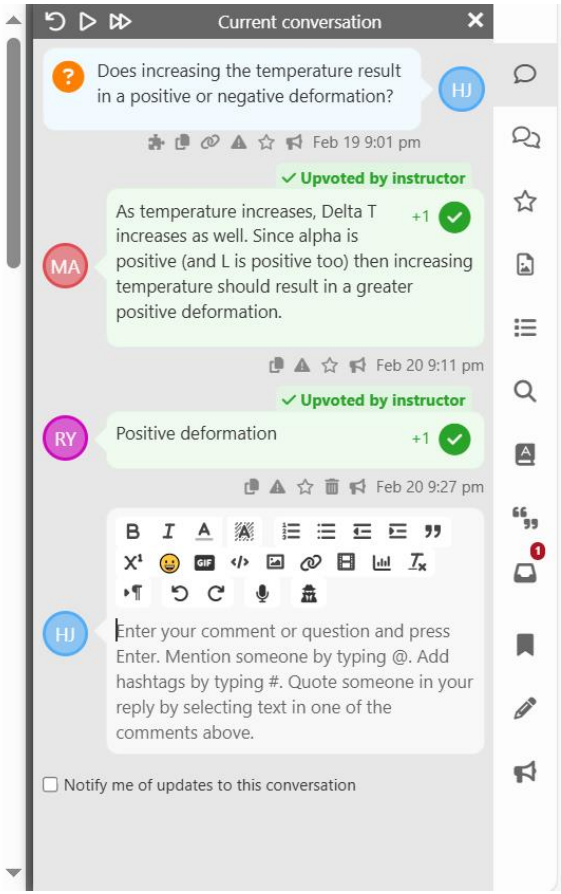
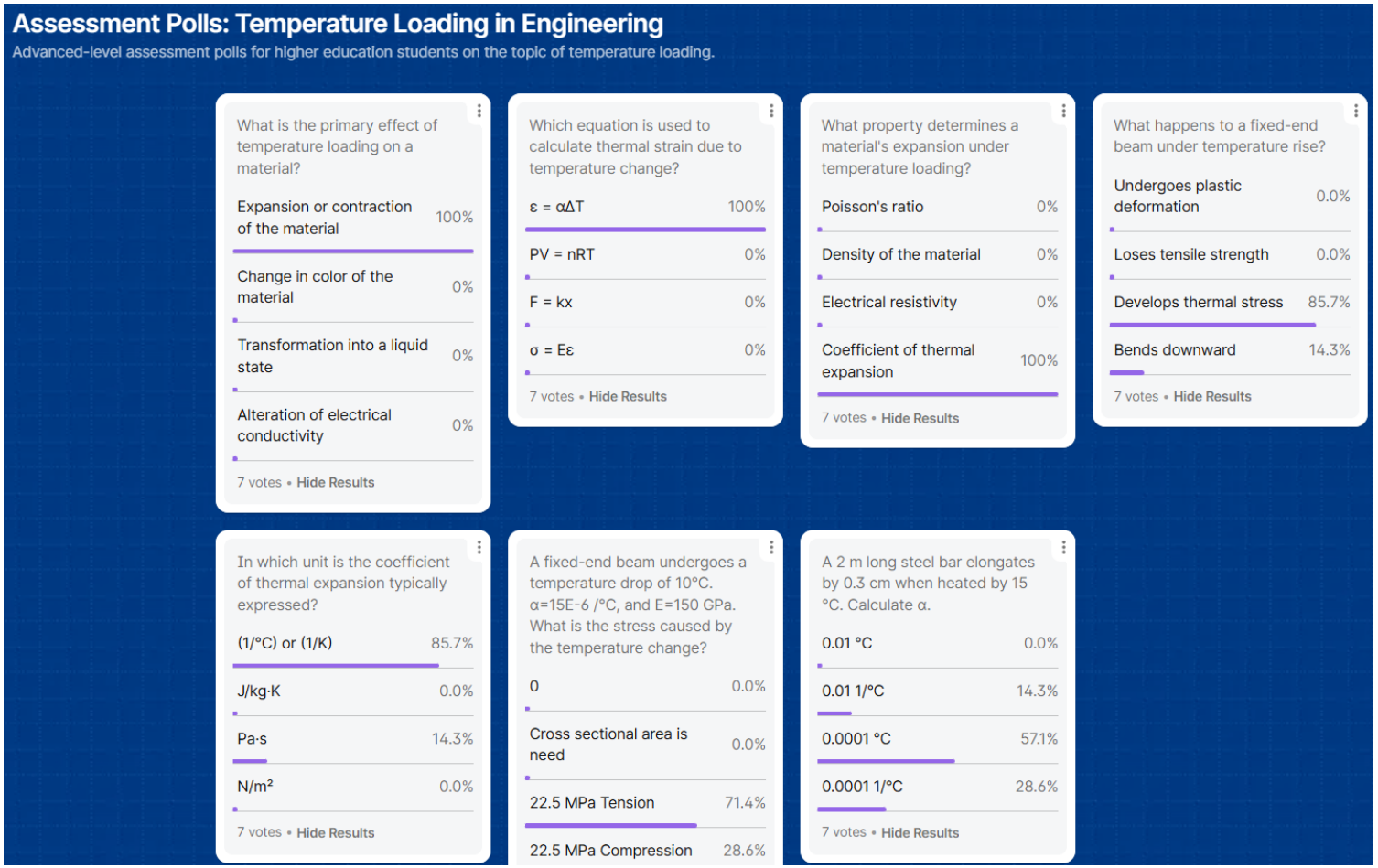


Fig. 9.28

units of length, α represents a quantity *per degree C*, or *per degree F*, depending whether the temperature change is expressed in degrees Celsius or in degrees Fahrenheit.



1 – Temperature Loading



1 – Temperature Loading

Activities

1 – Temperature Loading:

- Perusal reading
- Padlet poll
- In-class group activity

2 – Stress Transformation:

- Study of a slide
- Padlet discussion board
- Excel sheet demo
- Padlet poll
- In-class group activity

2 – Stress Transformation

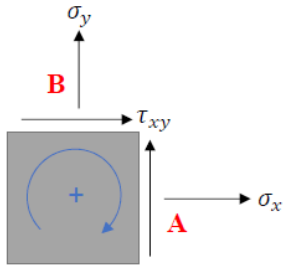
CIE202 – Chapter 14

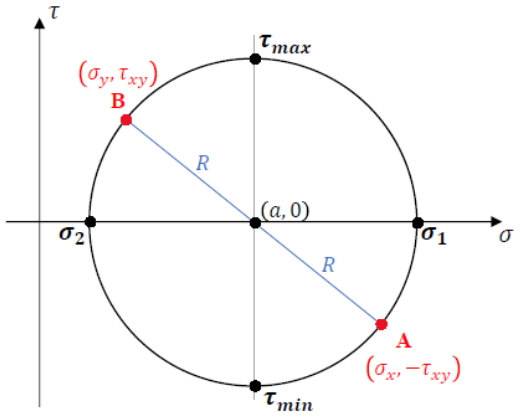
LAU Lebanese American University

Stress Transformation in 2D (Mohr Circle):

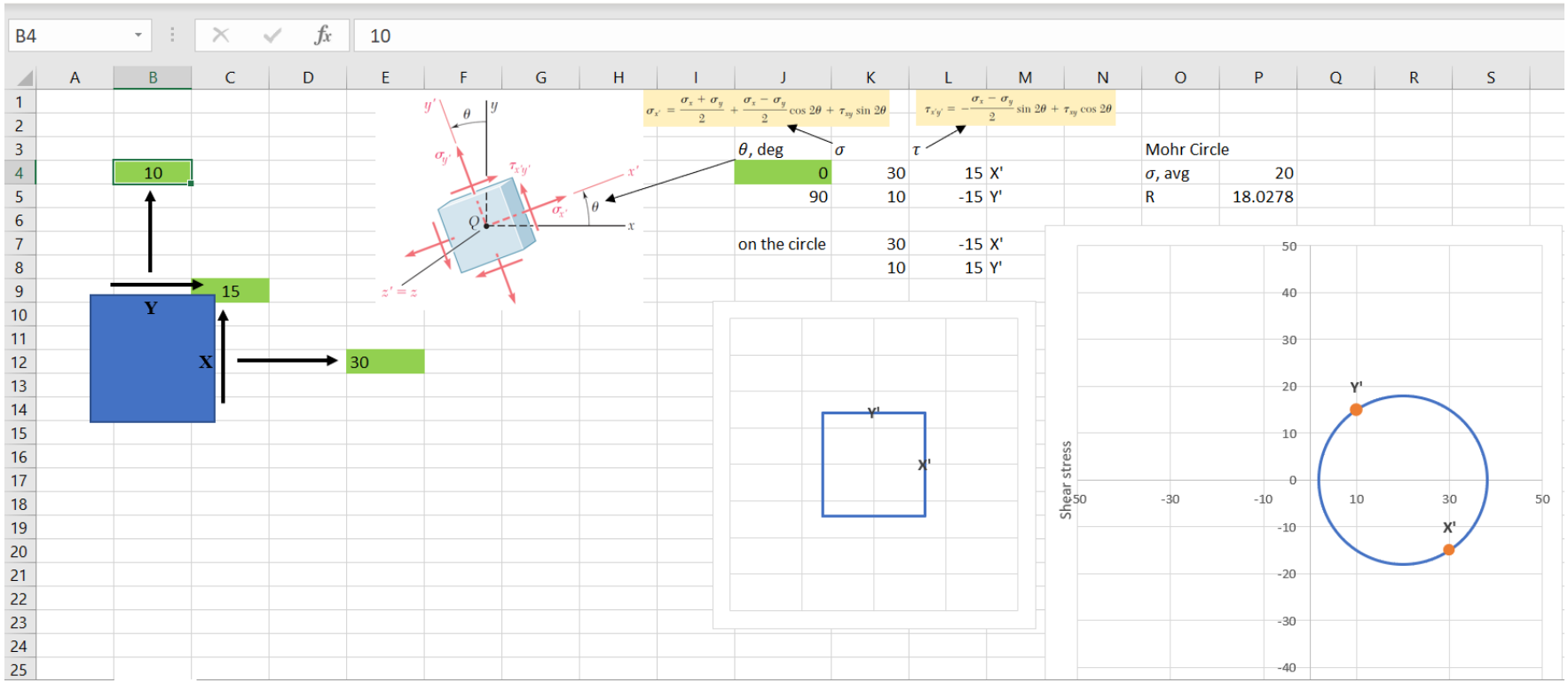
Notes: *(excel demonstration)*

- Stresses on two perpendicular planes plot on two diametrically opposite points on the Mohr circle
- ***General:*** a plane rotating by an angle θ corresponds to a point rotating by an angle 2θ on the circle, in the same direction.
- At σ_1 and σ_2, $\tau = 0$, and σ_1 and σ_2 are called principal stresses
- $\tau_{max} = R$
- If $\sigma_1 = \sigma_2$, the circle collapses into a point → no shear
- The sum of normal stresses on any two mutually perpendicular planes is constant and $= \sigma_x + \sigma_y$

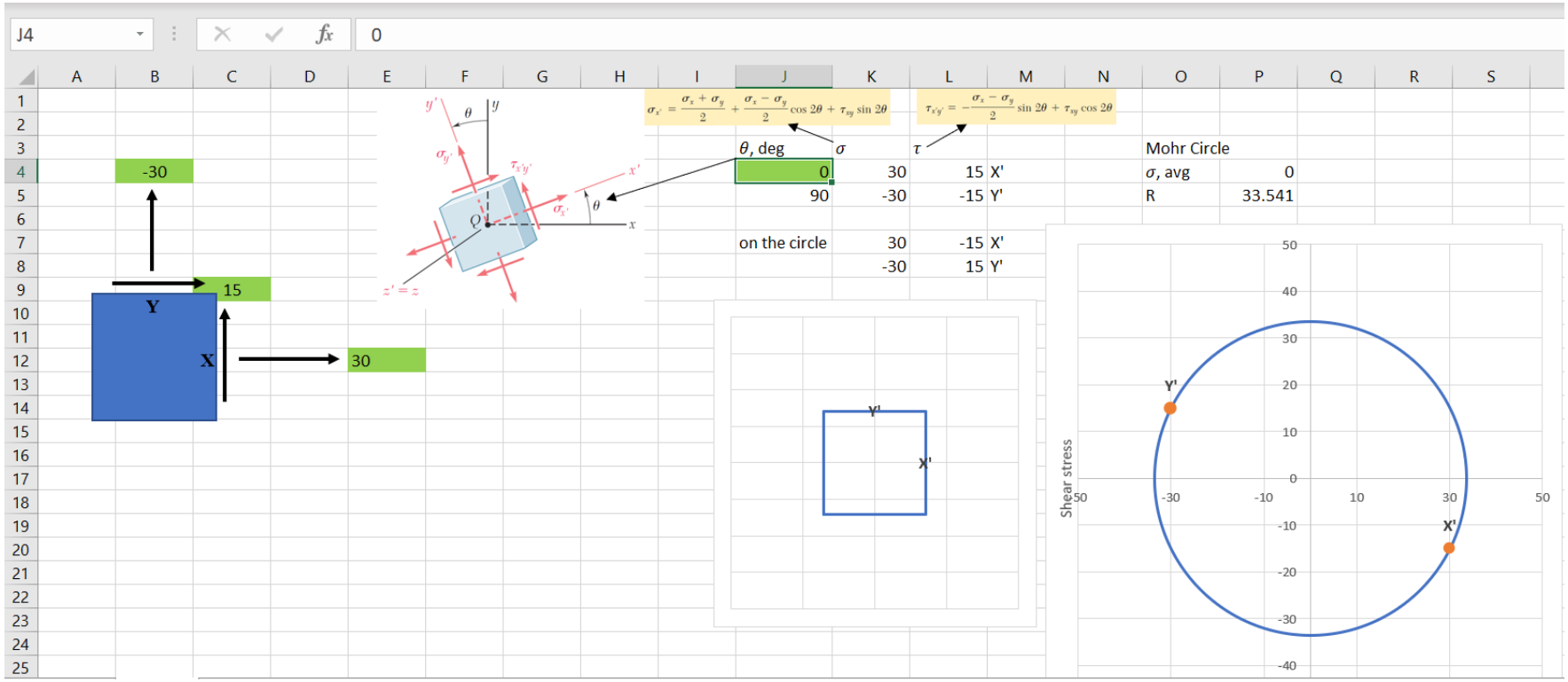




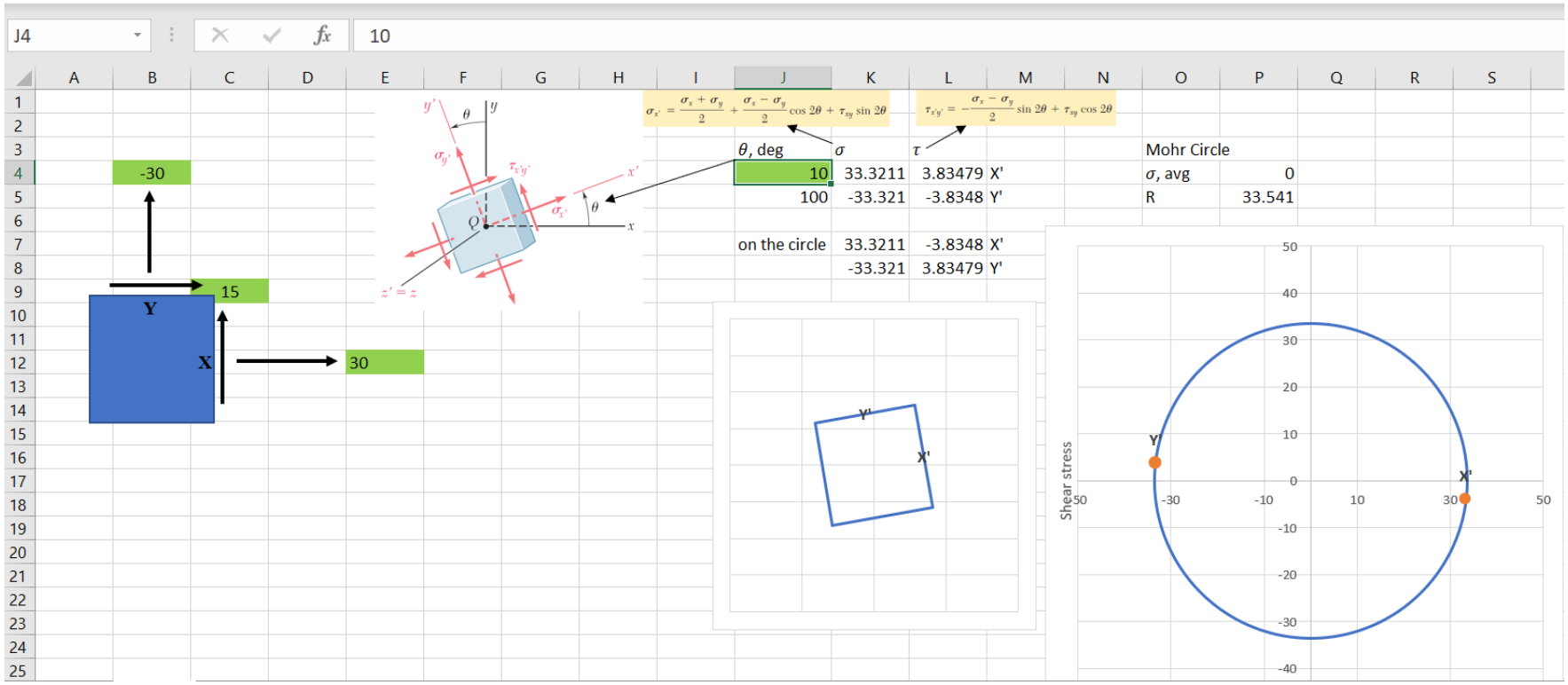
2 – Stress Transformation



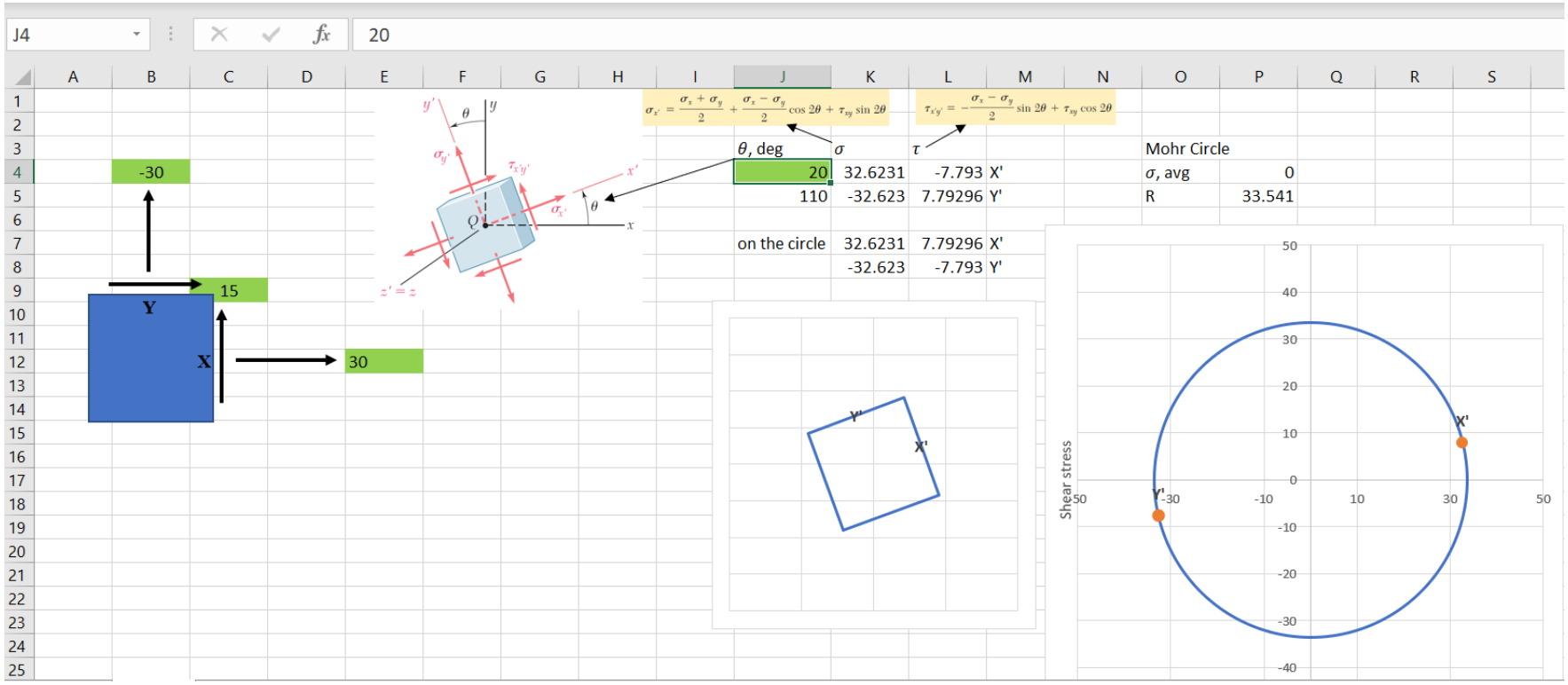
2 – Stress Transformation



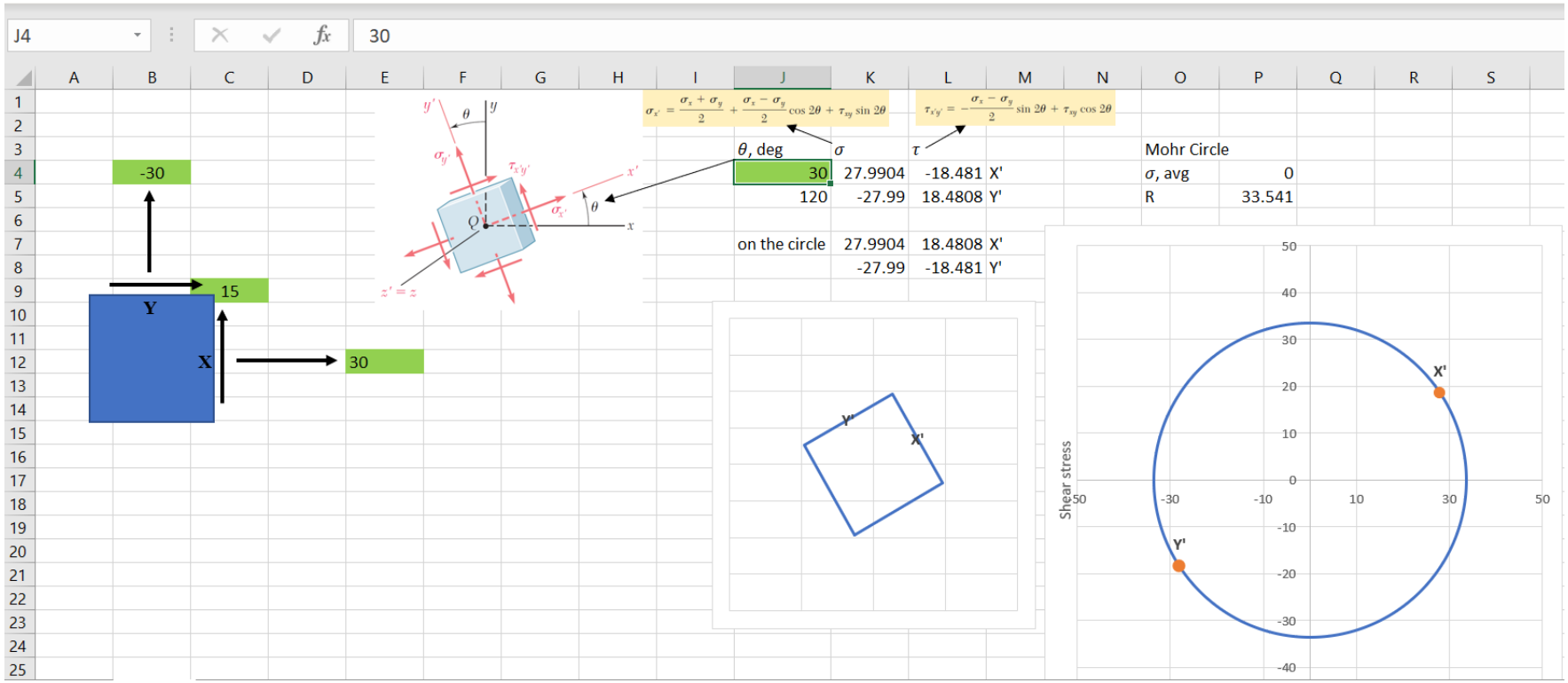
2 – Stress Transformation



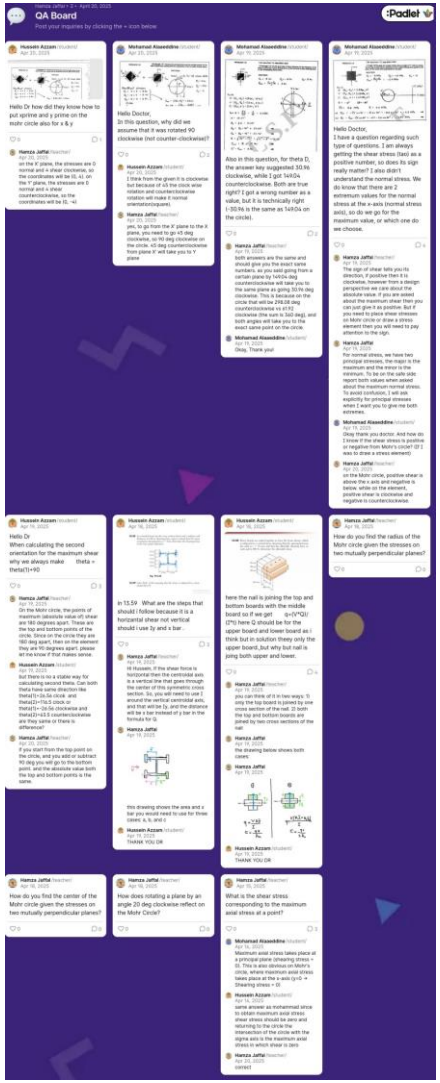
2 – Stress Transformation



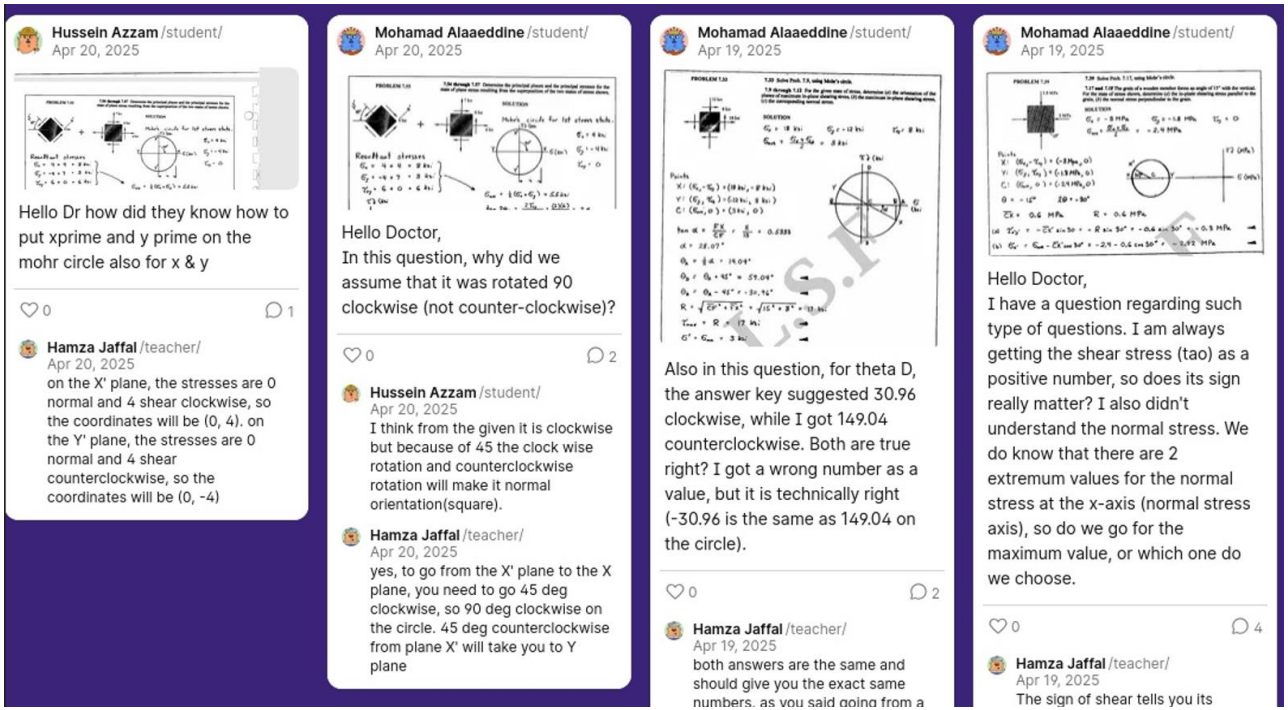
2 – Stress Transformation



2 – Stress Transformation



2 – Stress Transformation



Flipped Classroom

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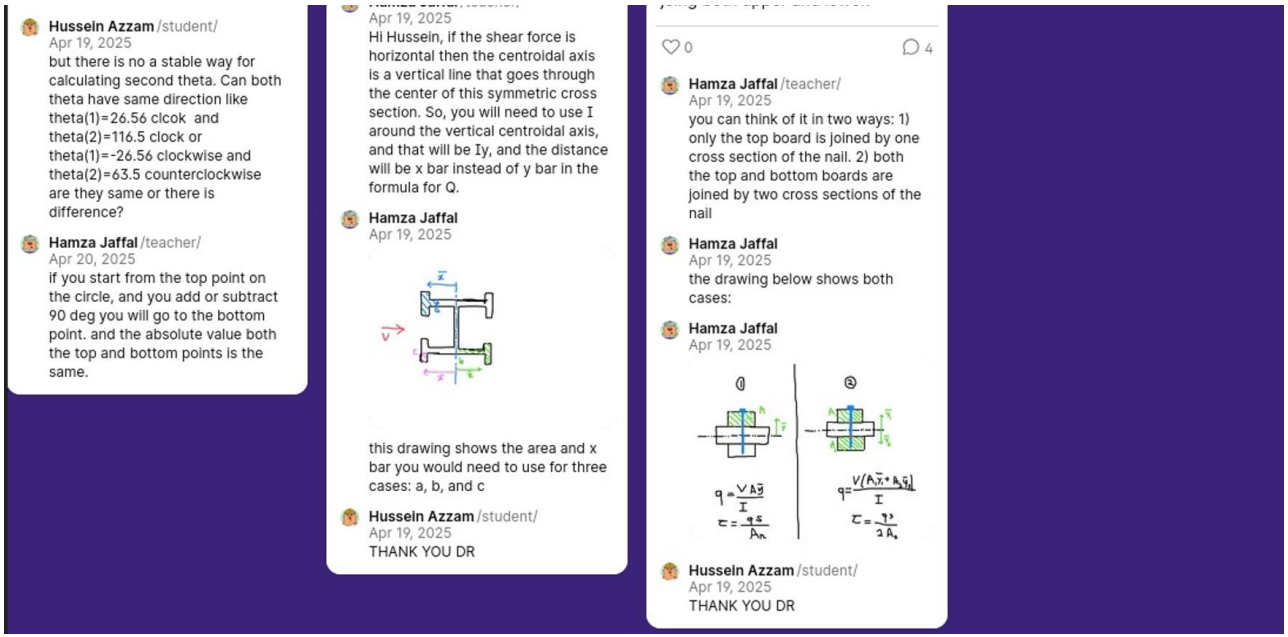
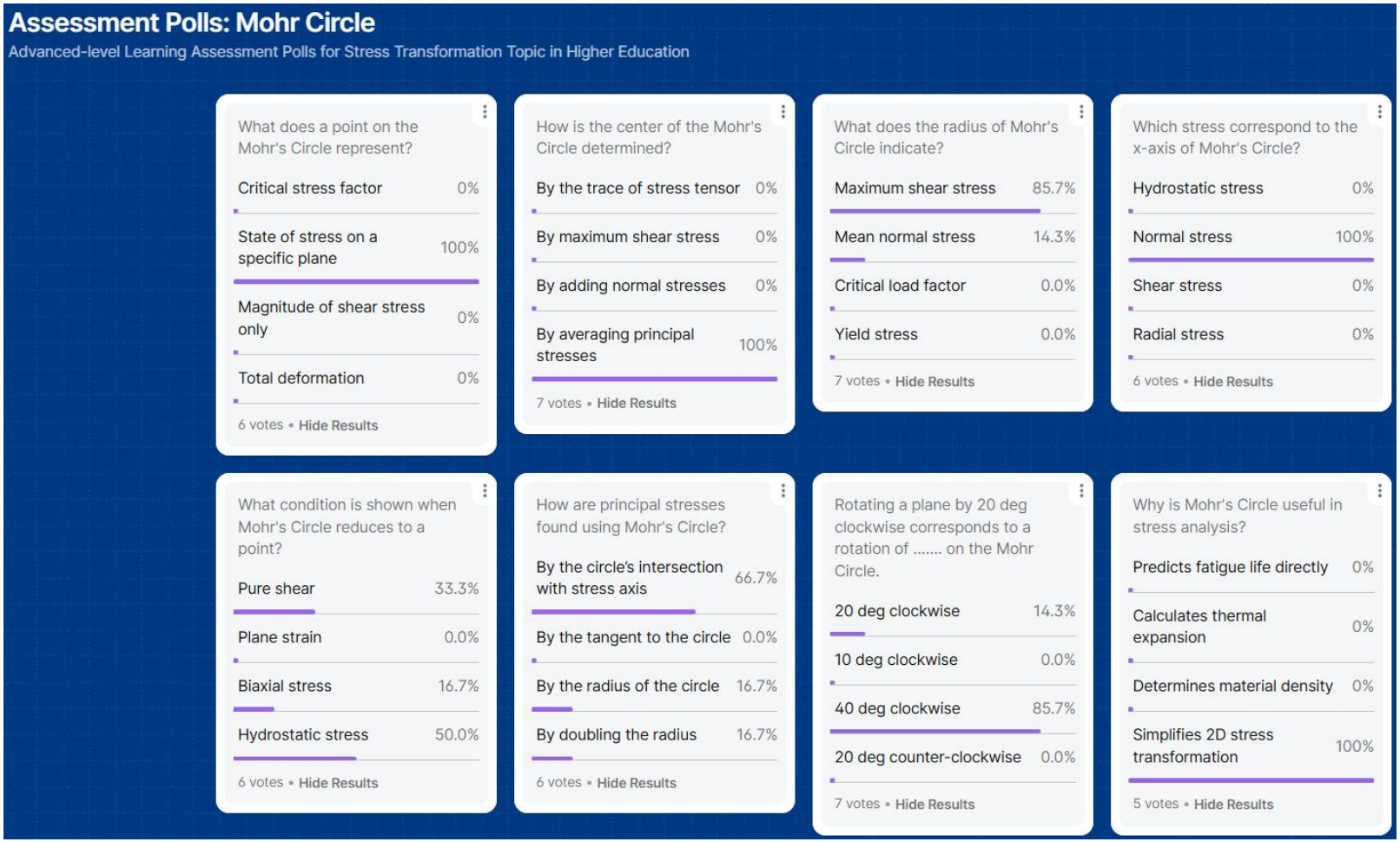
2 – Stress Transformation



2 – Stress Transformation



2 – Stress Transformation

CIE202: Mechanics of Materials Spring 2025

Stress Transformation – Class Activity

Consider the two following loading conditions:

1) A rectangular beam subjected to pure negative bending moment:
   Point of interest: a point at the top surface of the beam (the fibers with maximum tension)
2) A circular shaft subjected torsion:
   Point of interest: a point on the outer surface of the beam

Divide yourselves into two groups (3 or 4 students per group) and do the following for both cases:

a) On a piece of paper, draw the principal stress element clearly indicating its orientation.
b) Draw that element on the rubber beam.
c) Apply the load and inspect the strains.
d) Did you guess the principal stress element correctly? Explain.

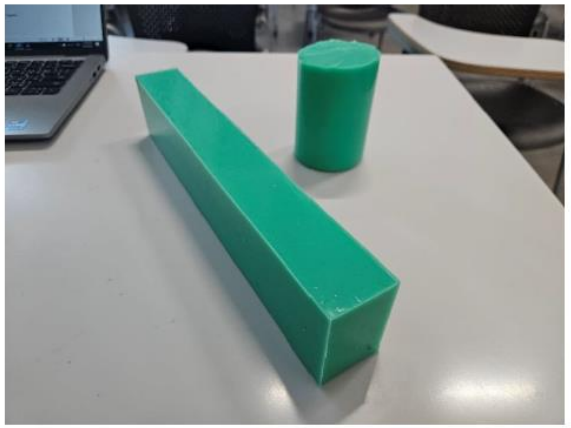
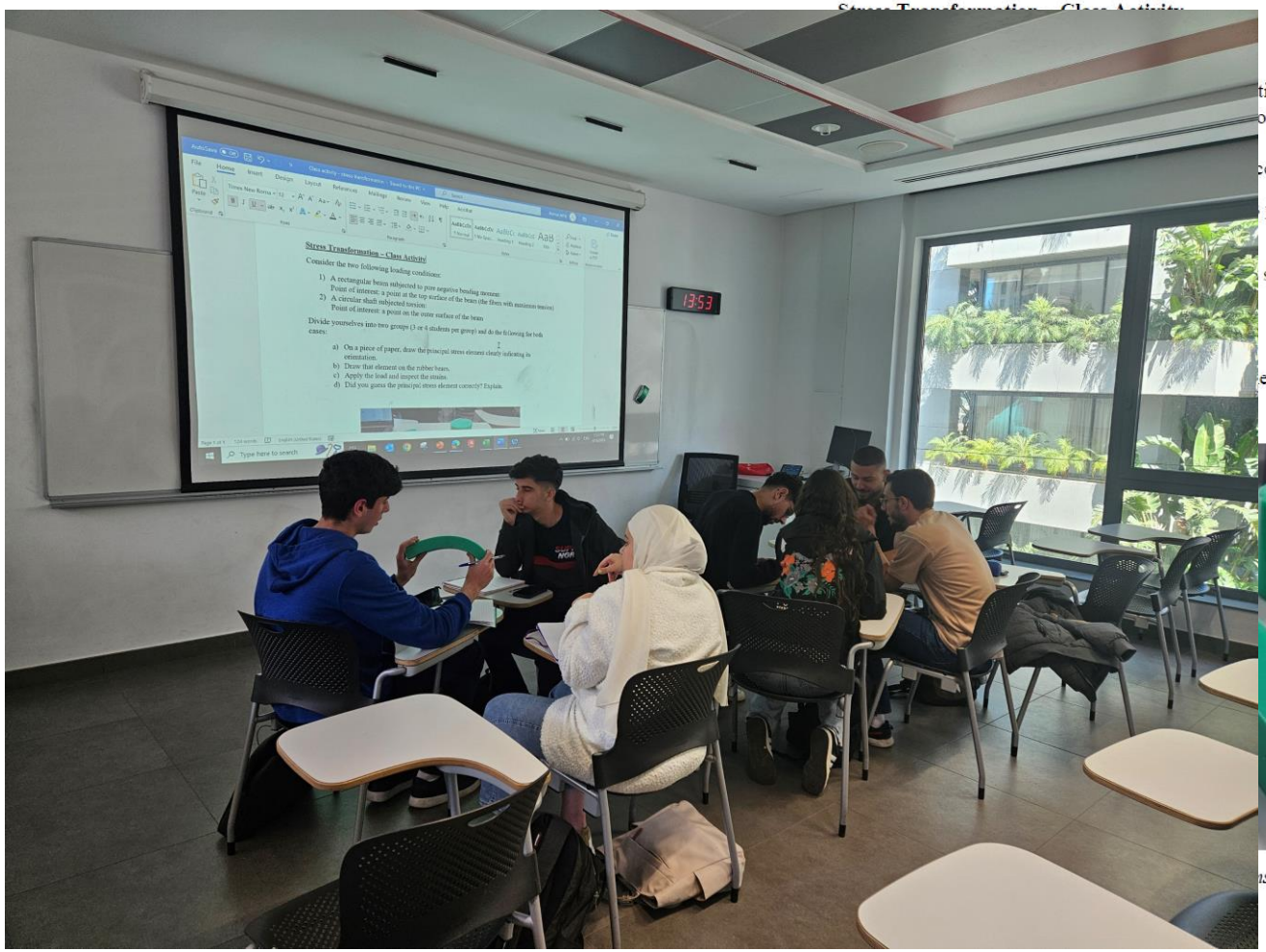


Figure 1: Silicone Rubber Beams used for the Class Activity

2 – Stress Transformation



CIE202: Mechanics of Materials Spring 2025

tive bending moment:
of the beam (the fibers with maximum tension)

ce of the beam

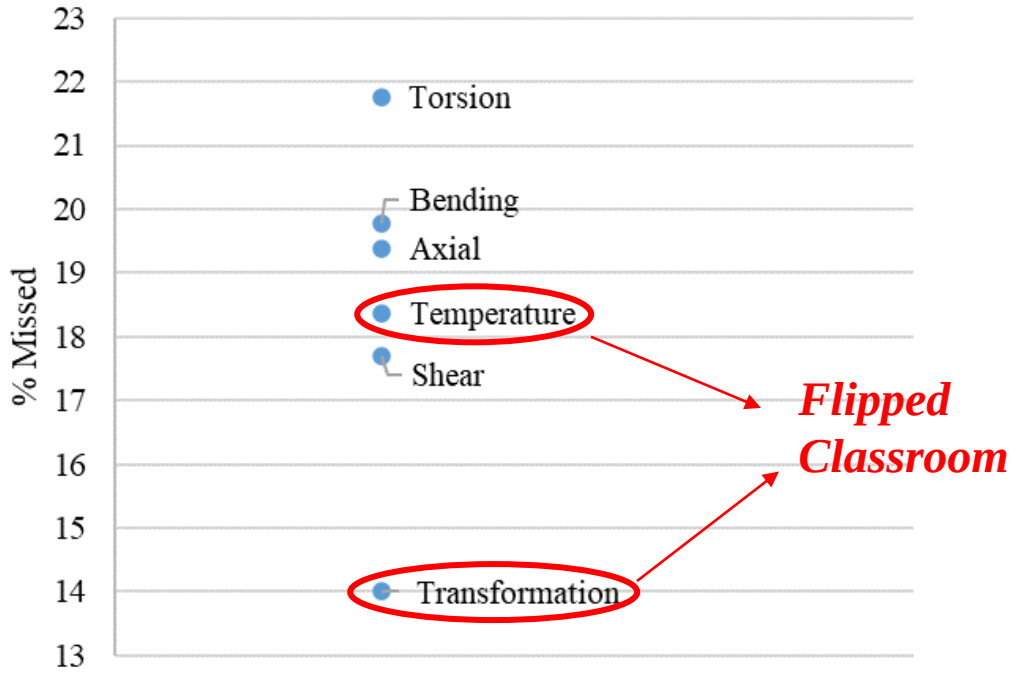
per group) and do the following for both

stress element clearly indicating its

ent correctly? Explain.

s used for the Class Activity

Statistics!


23
22
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% Missed
Torsion
Bending
Axial
Temperature
Shear
Transformation
Flipped
Classroom