

Building Industry-Ready Civil Engineers: Integrating Standards Education into the Civil Engineering Curriculum

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Innovation in Learning Center



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SOUTH ALABAMA

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**NIST Standards Services Curricula
Development Cooperative Agreement
Program Awardee Meeting**

September 12, 2025

Mobile, Alabama

- Two hours drive from New Orleans
- One hour flight from Atlanta
- 1.5 hour flight from Dallas and Houston



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Presentation Outline



Engineering
Accreditation
Commission

- Background and Objective
 - Overall Approach and Pedagogy
 - Modules Design
 - Results and Discussion
 - Conclusions
- **Bachelor of Science in Civil Engineering at University of South Alabama (USA)**
 - ABET-EAC Accredited
 - Approximately 190 students in the program
 - Average 35-45 graduates per year



Shenghua Wu



Min-Wook
Kang



John Cleary



Lisa
LaCross



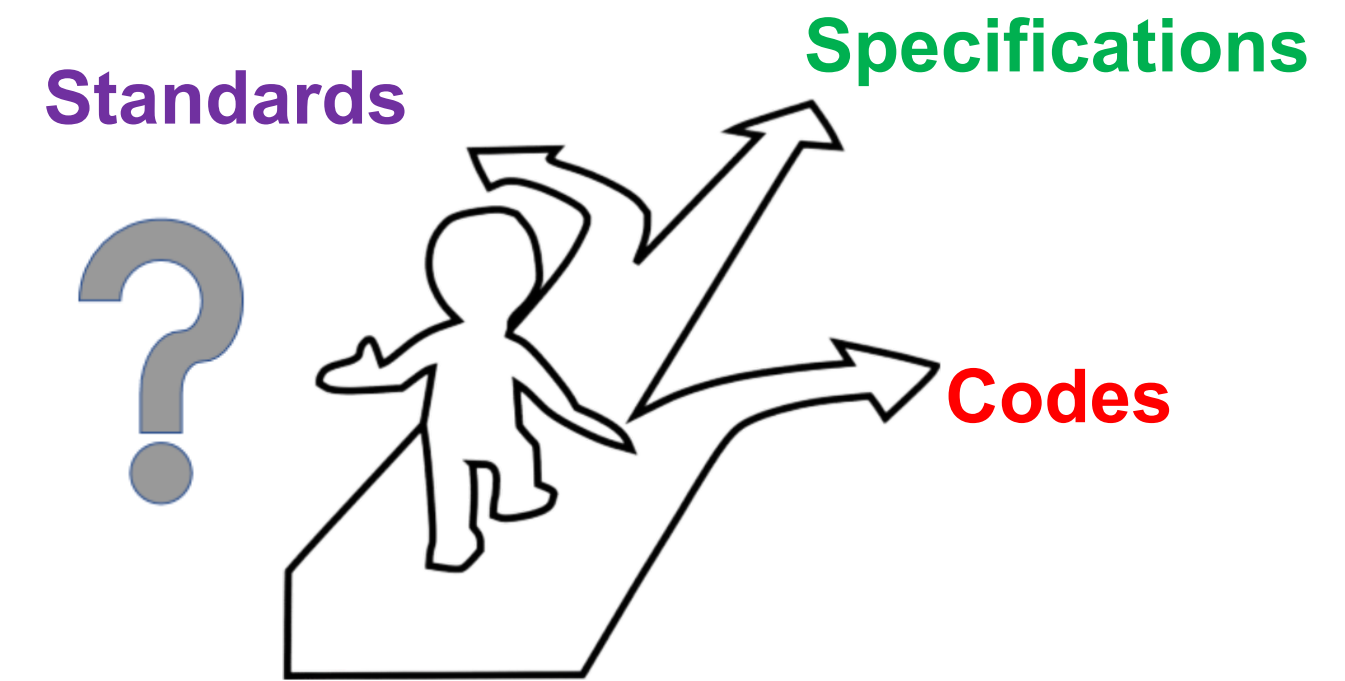
James P. Van
Haneghan



Former Graduate
Student
Pratik Neupane

Background

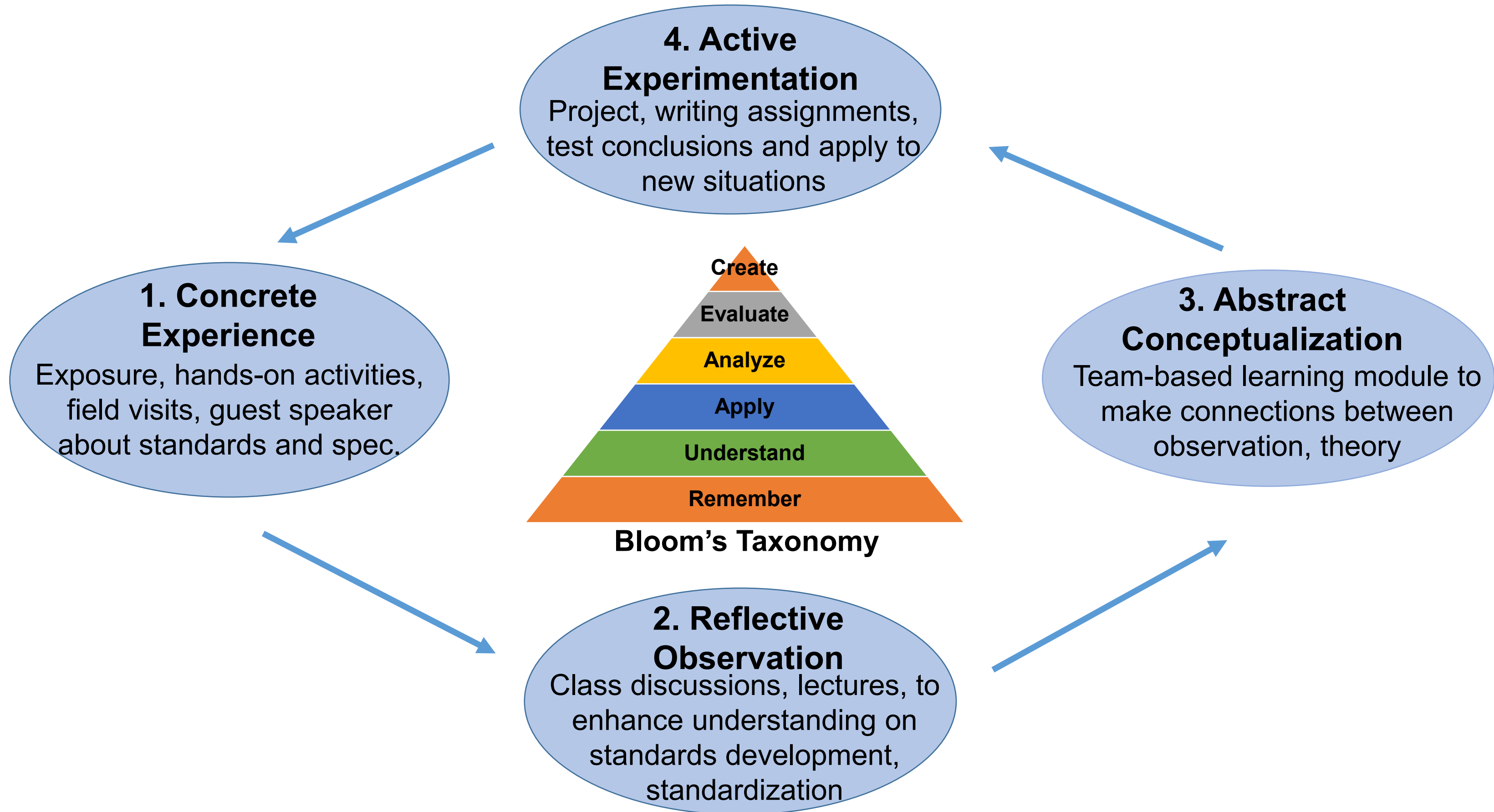
- Civil engineering is a highly dynamic profession with a **wide range of specifications and standards**, such as ASTM, AISC, ACI, AASHTO.
- **Limited formal and systemic education** on how to read and understand specifications, formal process of developing standards.



Objectives

- To explore a systematic approach to design and incorporate education on standards, codes, and specifications into the curriculum.
 - (1) Creating **user-friendly learning modules** that are straightforward to implement and accessible to students;
 - (2) **Integrating** these modules into courses while **assessing** their impact on **student learning outcomes** and overall **effectiveness**.

Overall Approach and Pedagogy: Experiential Learning Model



Modules Design

Level	Course Title	Relevance to Experiential Learning Model	Relevance to Bloom's Taxonomy
Freshman	Introduction to Civil Engineering	concrete experience, reflective observation	Remember, Understand, Apply
Sophomore	Mechanics of Materials	concrete experience, reflective observation, active experimentation	Understand, Apply, Analyze, Evaluate
Junior	Civil Engineering Materials and Lab	concrete experience, reflective observation, abstract conceptualization, active experimentation	Understand, Apply, Analyze, Evaluate, Create
Senior	Senior Design	concrete experience, reflective observation, abstract conceptualization, active experimentation	Apply, Analyze, Evaluate, Create
Graduate	Advanced Characterization of Transportation Materials	concrete experience, reflective observation, abstract conceptualization, active experimentation	Apply, Analyze, Evaluate, Create

CE102 Introduction to Civil Engineering

- Topics Covered:

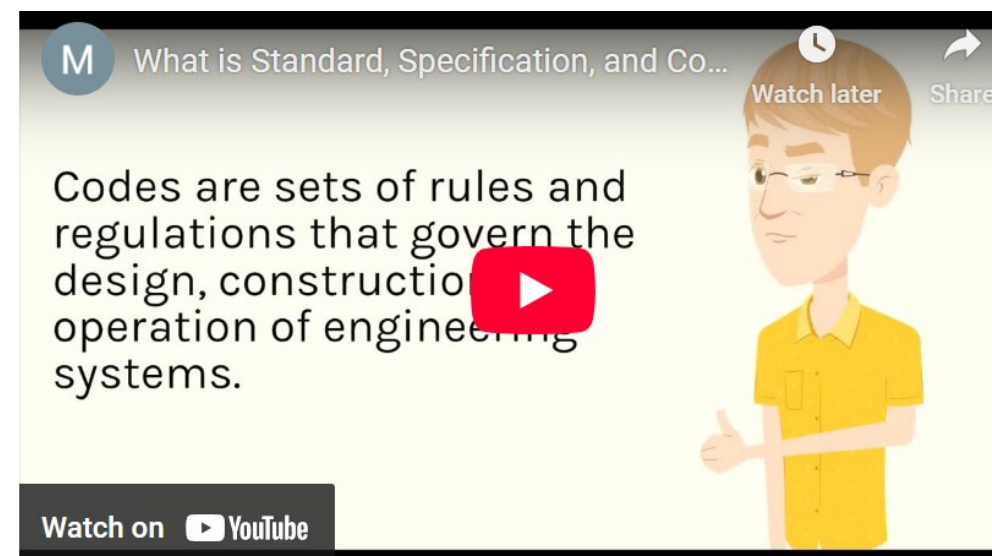
1. Course Syllabus and Academic Policies
2. Understanding Civil Engineering
3. Civil Engineering Sub-disciplines
4. Basic Freehand Sketching Methods
5. Map Scale and Units
6. CAD Drawings with MicroStation
7. (Individual) CAD Project
8. Spreadsheet Applications for CE Problems

9. Group Project

- Use AI-empowered videos to introduce NIST and standards

Group Project Example

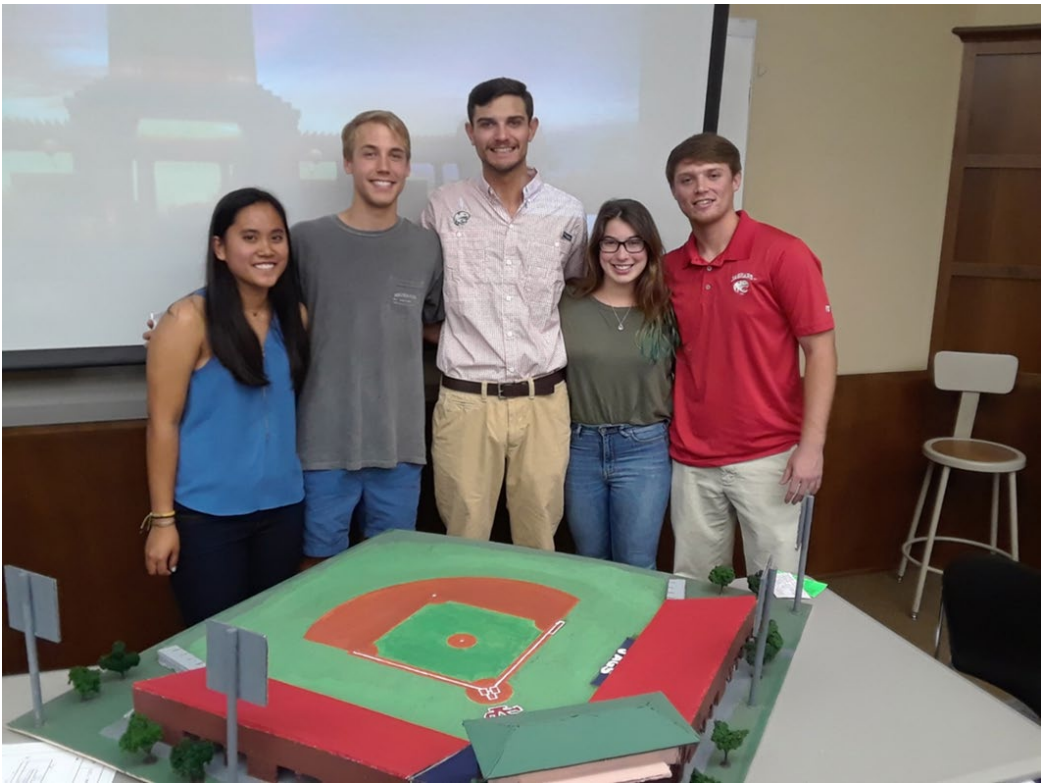
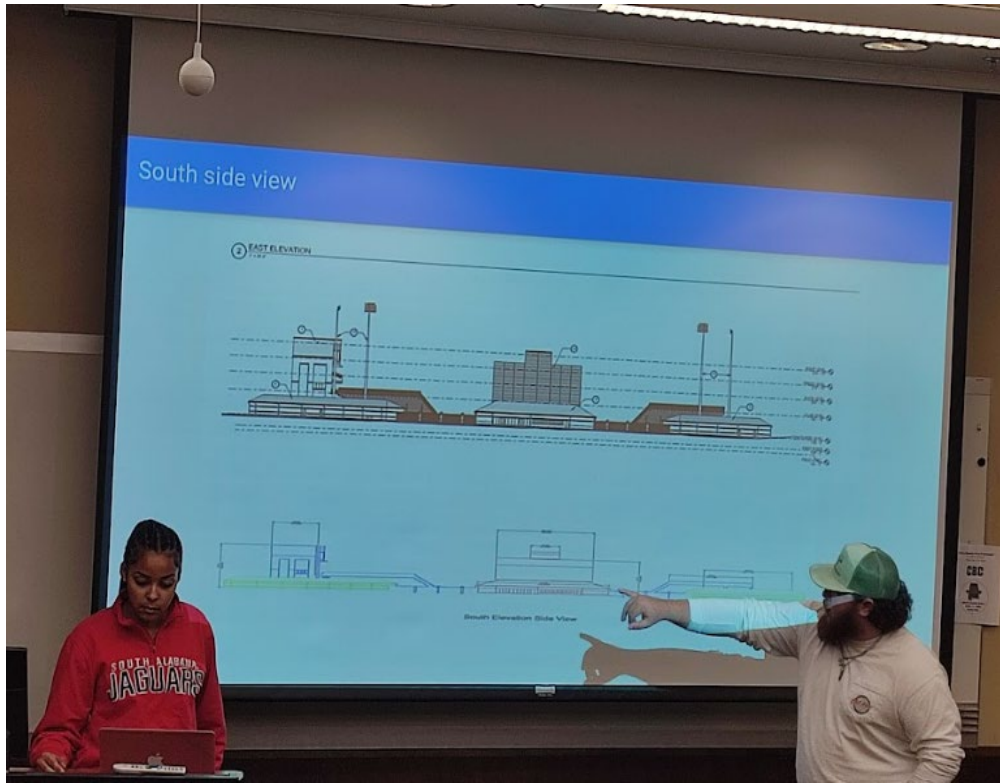
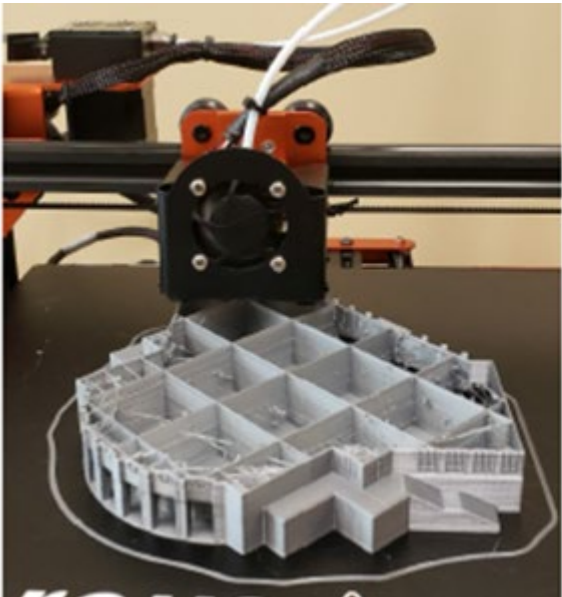
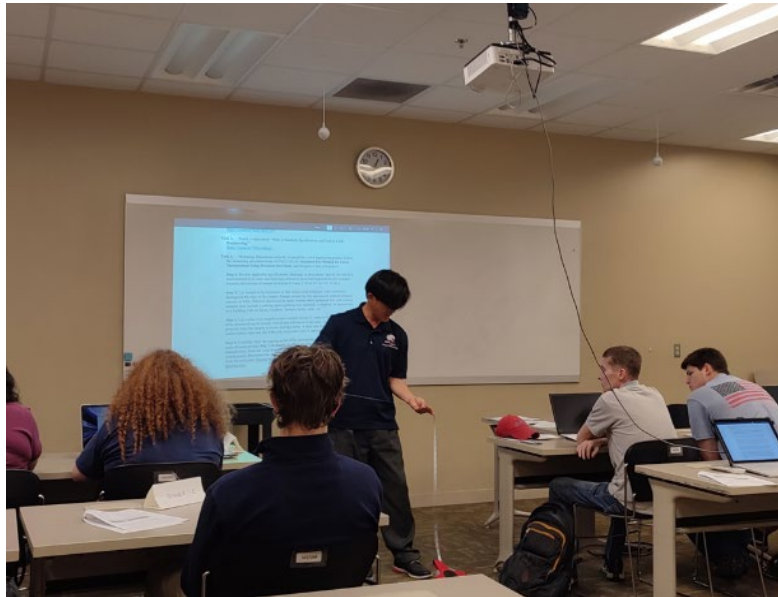
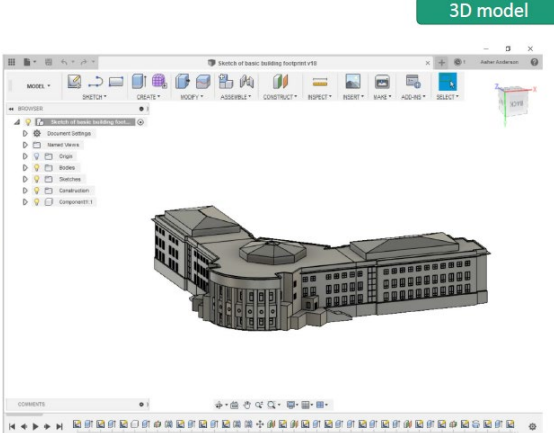
- **CAD Drawings** of:
 - ⊙ USA Campus Buildings
 - Bell Tower, Shelby Hall, MSPB, Mitchell Center
 - Stanky Field, Football Stadium, RAC
 - ⊙ Others: Cochrane Bridge; RSA Tower, etc.
- **Scaled 3D Models & 3D Printing** of
 - ⊙ USA Campus Buildings
 - Shelby Hall, Bell Tower, Stanky Field, Laidlaw Performing Arts Center, Chemistry Building
- **Video Cast**
 - ⊙ USA Civil Engineering Program
- **Engineering (Technical) Report:**
 - ⊙ Storm water manag. issue of Shelby Hall parking lots
 - ⊙ Traffic safety & operation issues on USA South Drive



CE102 Introduction to Civil Engineering

- Use Group Project to Introduce ASTM Standard

Shelby Hall
3D Printing



CE 102: Intro to Civil Engineering

Spring 2024

GROUP PROJECT TITLE: South Alabama Moulton Tower - 3D Model and Measurements

GROUP INFORMATION:

Group Number	Group Member	
	Name	J Number
3	Bryant Lowe	J00689121
	Harley Hooper	J00732322
	Preet Patel	J00726777
	Jackson Martin	J00708406

GROUP PROJECT DESCRIPTION:

Backgrounds:

- Explain why you choose this topic
- We chose the Moulton Tower since it is the tallest bell tower in the state of Alabama, and because it is named after the University of South Alabama's second president, Gordon Moulton. Building the model will give us good practice at forming a 3D model.

Objective

State your project objective briefly.

- To understand the history, size, and measurements of the Moulton Tower
- To become more familiar with how to build a 3D model example

Tasks

Illustrate what tasks you are going to do:

- Task 1: Create a project outline and submit it on time
- Task 2: Measure the dimensions of the structure based on the ASTM F2203-13C standard test method for linear measurements using a precision steel ruler.
- Task 3: Obtain blueprints of the building
- Task 4: Keep updating the outline as we gather more information.
- Task 5: Buy the material to build a 3D model
- Task 6: Start putting the model together
- Task 7: Complete the 3D model and prepare the group presentation
- Task 8: Submit project outputs

Project area: The study area of this project is the Moulton Tower located in the USA main campus in Mobile, Alabama. See Figure 1.

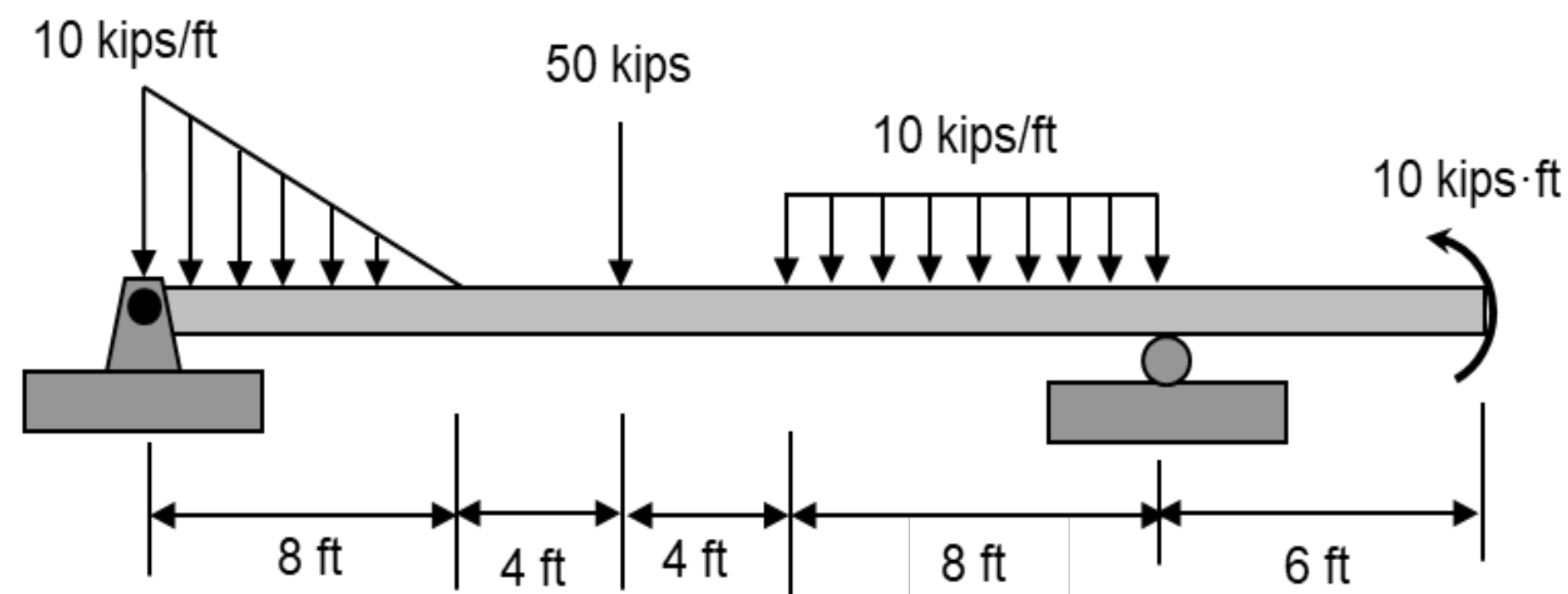
CE102 Introduction to Civil Engineering

- Faculty-led Field Trip to Alabama Department of Transportation (ALDOT) Traffic Management Center and George Wallace Tunnel



EG315 Mechanics of Materials

- Team Project
 - Scenario: Imagine working for an engineering firm. To impress your supervisor, form a six-person team to design a Wide Flange (W) beam that can support external loading.
 - Deliverable: A technical report that thoroughly justifies the selection and demonstrates analysis techniques, using the American Institute of Steel Construction (AISC) specification.



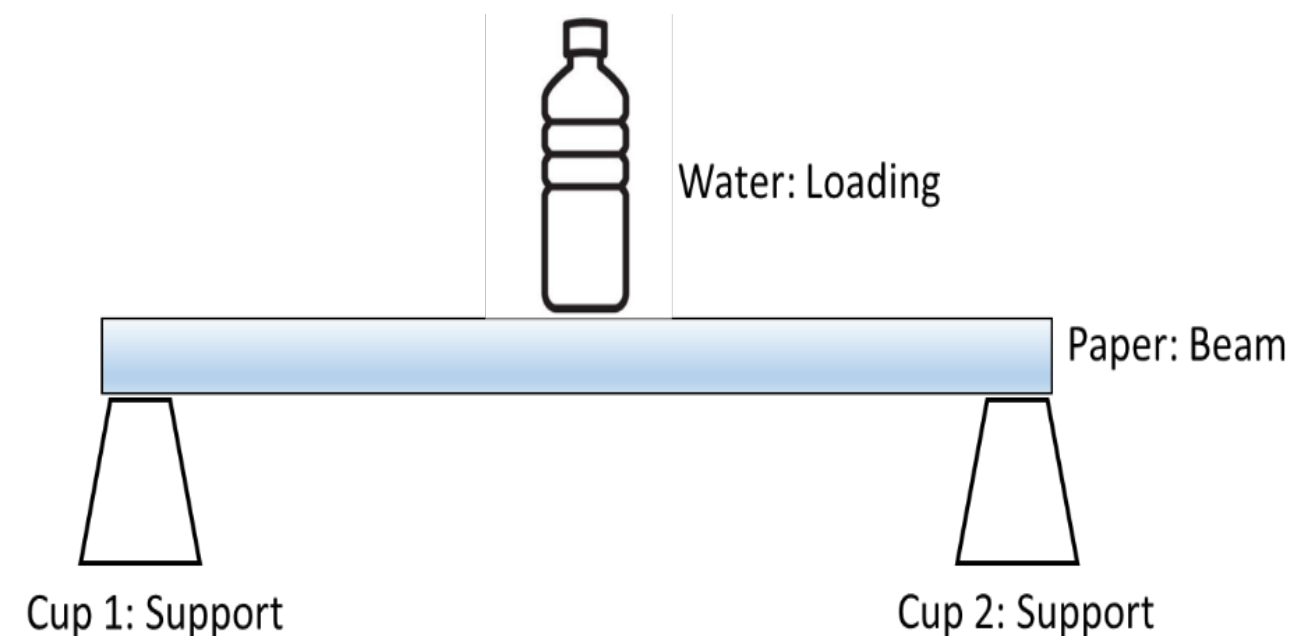
Items	Requirement	Maximum Points	Points Awarded
1. Cover Sheet	Included, professional, and accurate	5	
2. Table of Contents	Included, professional, and accurate	5	
3. Problem Statement	Included, professional, and clear	5	
4. Approach	Clear and logic	5	
5. Analysis & Results	Correct shear/moment diagrams	15	
	Correct beam selection for W-beam	15	
	Correct Mohr's circle and principal stress	15	
	Identified locations that possibly exceed allowable stresses	15	
6. Conclusion	Summarize and conclude your design. Demonstrate the use of standards or specifications.	10	
7. References	Included as required	5	
8. Appendix	Included as required	5	
Bonus 1: Determine the maximum deflection and location		5	
Bonus 2: Submission is punctual, professional, neat, clear, and logical; Demonstrated a collaboration and active communication		5	
Total (Possible)		100+10	

EG315 Mechanics of Materials

- Team Building Activity



- In-Class Group Activity to Understand “Deflection” of Beam
- Work as a group: How can you use the paper as a beam to support a water bottle (as the load) using two cups (as supports)?
- Next, consider this: What are effective ways to reduce the deflection of a simply supported beam? (Five different approaches)



EG315 Mechanics of Materials

- Field Trip to AM/NS Calvert, Local Steel Manufacturer



CE314/315 Civil Engineering Materials and Lab

- Field Trip to Local Asphalt Plant (H.O. Weaver and Sons, Inc.)

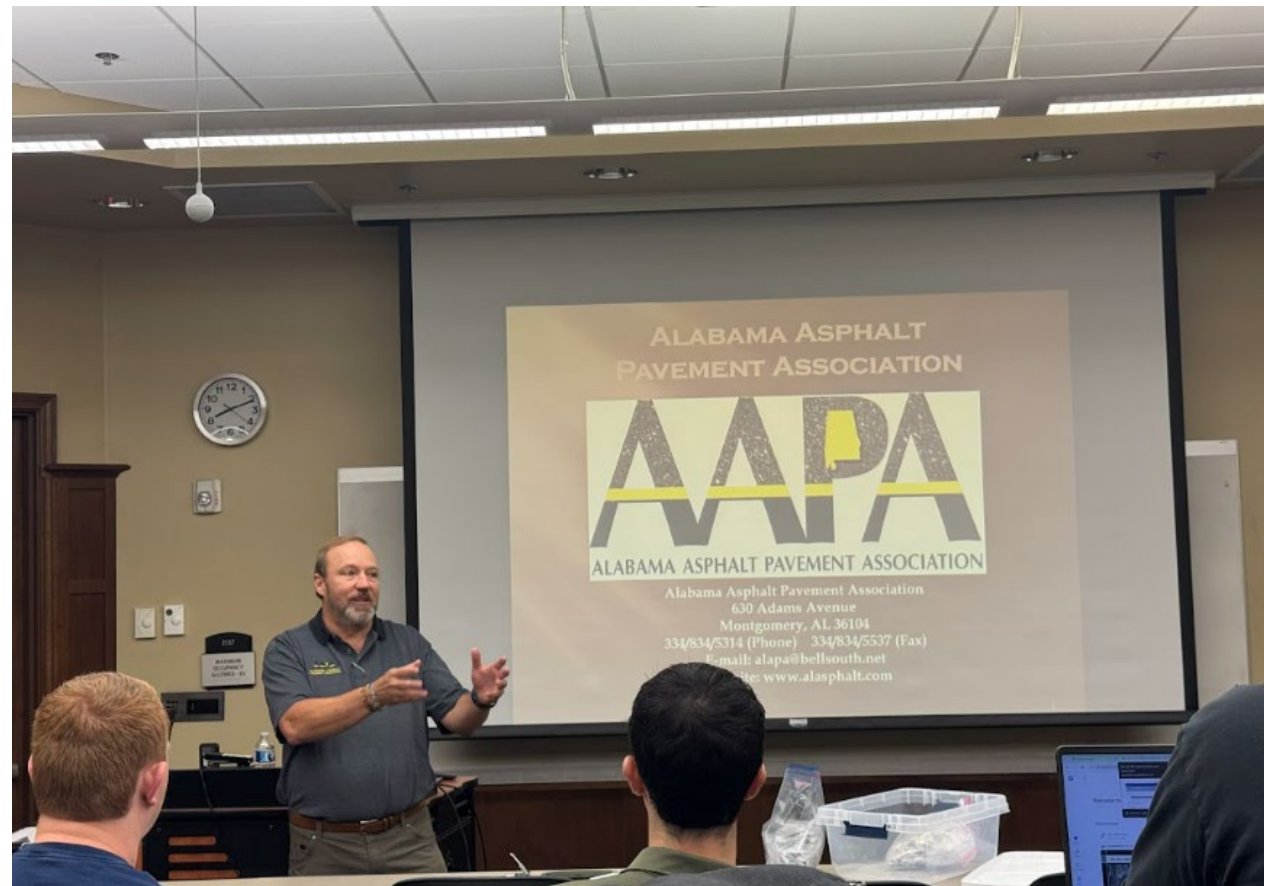


- Objective:** To gather **real-world information** on production of hot mix asphalt and connect the learnt knowledge to the **asphalt industry**, as well as foster effective communication with engineers.
- An individual memo will be requested to submit to your supervisor, summarizing your observations from the site visit.

CE314/315 Civil Engineering Materials and Lab

Guest Lecture and Online Quiz

- Mr. Mel Monk from Alabama Asphalt Pavement Association delivered a lecture on asphalt pavements, emphasizing sustainable practices like Reclaimed Asphalt Pavement (RAP).
- The interactive session provided students with real-world insights, bridging the gap between classroom learning and industry applications.
- An online quiz was designed to assess students' understanding of guest speaker's work.



CE314/315 Civil Engineering Materials and Lab

- **Objective:**
 - ✓ Hands-on experience for **applying** standards, codes and specifications through **experiments**
- **Key Steps:**
 - ✓ Provide **ASTM/AASHTO** specifications and standard as well as testing procedure
 - ✓ Team work for conducting experiment
- **Skills Developed:**
 - ✓ Standards and specification **reading and comprehension**
 - ✓ **Data analysis and calculation** of testing results: are results making sense?
 - ✓ **Application** of theoretical knowledge to real-world engineering practices



CE314/315 Civil Engineering Materials and Lab

- **Objective:**
 - ✓ To develop and demonstrate **effective communication skills and critical thinking skills** as future civil engineers through group work.
- **Key Steps:**
 - ✓ Create and deliver professional presentations tailored for technical and general audiences.
 - ✓ Research and present on selected topics
 - ✓ Effective PowerPoint design, provide rubrics to evaluate

Recycled Plastics in Asphalt

Dept. of Civil Engineering
University of South Alabama
12/5/24



Sky Anderson | Zach Burkett | Jake Weber | Kylie Hudson



3-D PRINTED CONCRETE

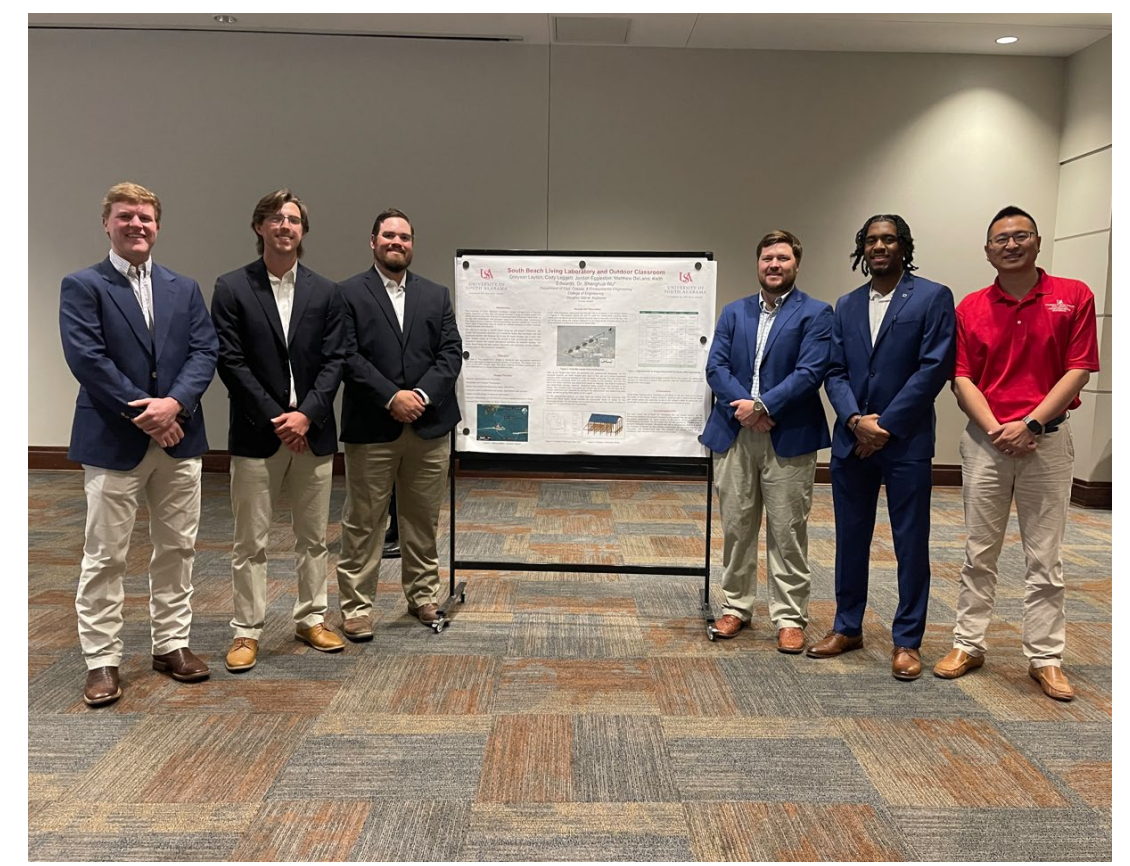
Group 3: Ethan Walker, Reid Holland, Parker Perry, Noah Pickens
University of South Alabama department of Civil, Coastal, and Environmental Engineering
12/3/24

A photograph showing a 3D printed concrete structure, which appears to be a series of stacked, curved, and layered concrete pieces, demonstrating the capabilities of 3D printing in construction.

CE 432 Senior Design

- **Objective:**

- ✓ Students will be able to demonstrate their **proficiency in applying standards** to real-world problems, as well as their ability to work effectively as part of a team and **communicate their findings** clearly and concisely.



- Symposium to present work to industry professionals for feedback

CE 490/590 Advanced Characterization of Transportation Materials

- **Objective:**

- ✓ Objective 6 (new): Students will be able to interpret standards, codes, and specifications, understanding their development and applications.

Lectures/Homework

- Lectures: introduce asphalt materials specification
- Homework Example: Compare AASHTO T324 and AASHTO T340 for characterizing the asphalt mixtures' rutting resistance; To enhance students' understanding on specification and the skill to summarize the technical information.

Comparison Items	AASHTO T324	AASHTO T340
1. Devices	Hamburg Wheel-Track Testing	Asphalt Pavement Analyzer (APA)
2. Test sample dimension		
3. Sample conditions: Water bath or air bath?		
4. Test temperature		
5. Test sample condition time prior to test		
6. Test hours		
7. Loading type and value		
8. Testing parameters		
9. Adopted by which states?		
10. Overall comments (e.g. feasibility, cost, difficulty to operate, etc.)		

Field Trip

- Blacklidge Emulsion Inc. Visit: to relate theoretical knowledge with practical applications
- Write a 1-page field memo that summarizes what you learnt from this visit, including: What type of standards and specifications do they use?

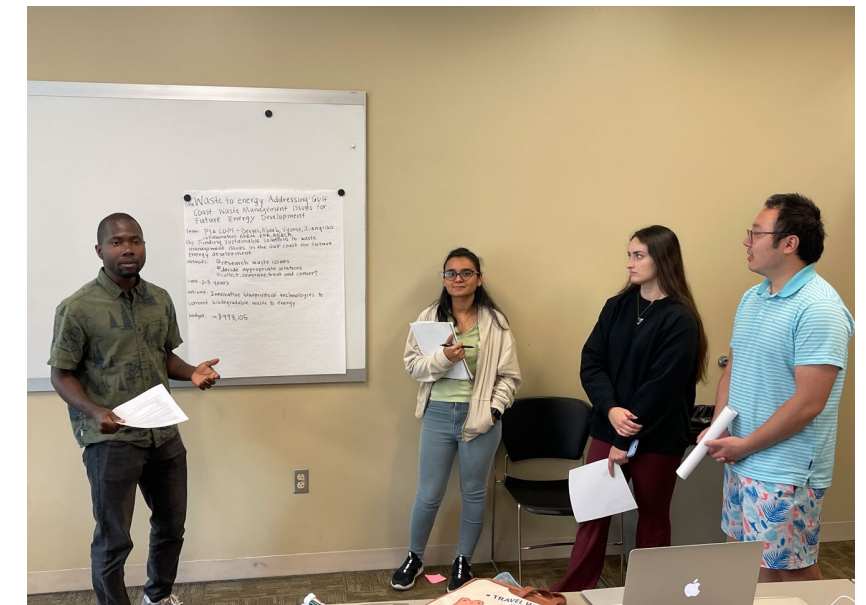
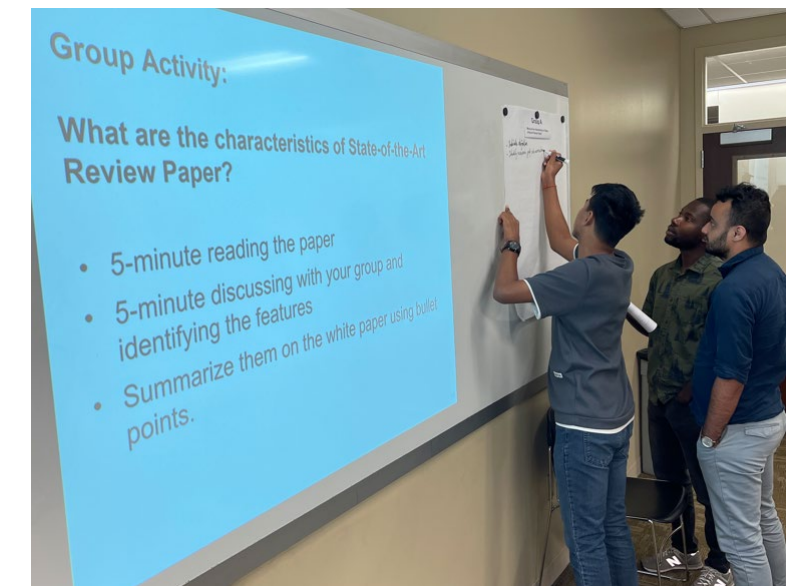
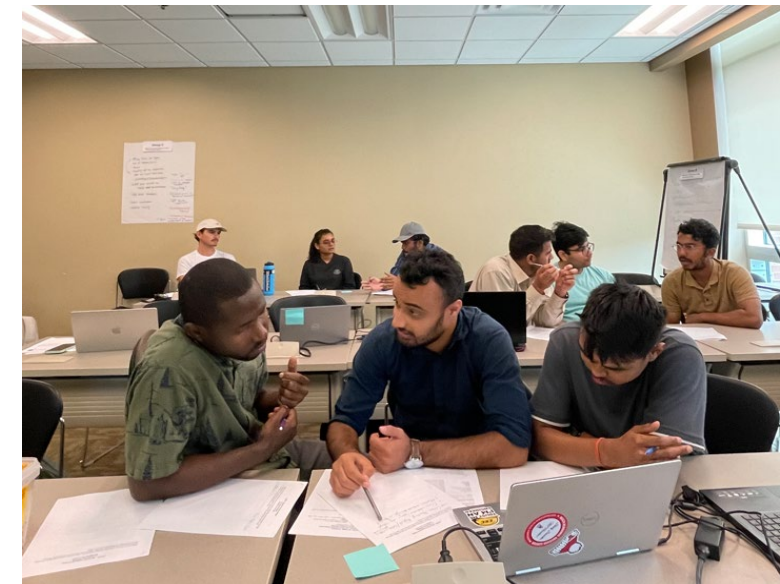


CE 590 Technical Writing for Research

- **Objective:**

- ✓ To develop and implement a summer course for improving **technical writing skills** for civil engineering students; Ambitious Goal: Each student will have a state-of-the-art review manuscript ready for submission to a journal.

Week	Date	Topic	Assignment
1	Thursday 5/30	1st In-person Meeting: Introduction, setting up goal, topic selection, research life cycle, ethics and misconduct	In-class activity
2	Thursday 6/6	2nd In-person Meeting: Writing skill topics (Illustration, Data Analysis, Writing, Citation, References, etc.)	In-class activity
3	6/10 to 6/16	Writing and weekly check-in	Paper outline
4	6/17 to 6/23	Writing and weekly check-in	-
5	6/24 to 6/30	Writing and weekly check-in	-
6	7/1 to 7/7	Writing and weekly check-in	First paper draft
7	Thursday 7/11	3rd In-person Meeting: Peer review, address comments, and respond	Peer review
8	7/15 to 7/21	No in-class activity	Final paper
9	7/22 to 7/26	4th In-person Meeting: Proposal writing	In-class activity



Presentation Outline

- Background and Objective
- Overall Approach and Pedagogy
- Modules Design
- Results and Discussion
- Conclusions

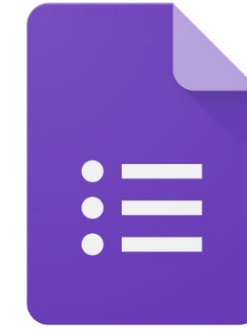
Surveys

- **Analysis Methodology**

- Survey conducted using Google Forms with 21 questions.
- Include open-ended, rating scale, checkbox, and single-answer types.
- Cover experiences, confidence, consequences, education on standards and specification

- **Survey Statistics**

- 123 students from Spring 2024 to Fall 2024
 - ✓ Freshmen: 13
 - ✓ Sophomores: 27
 - ✓ Juniors: 47
 - ✓ Seniors or Graduate Students: 36

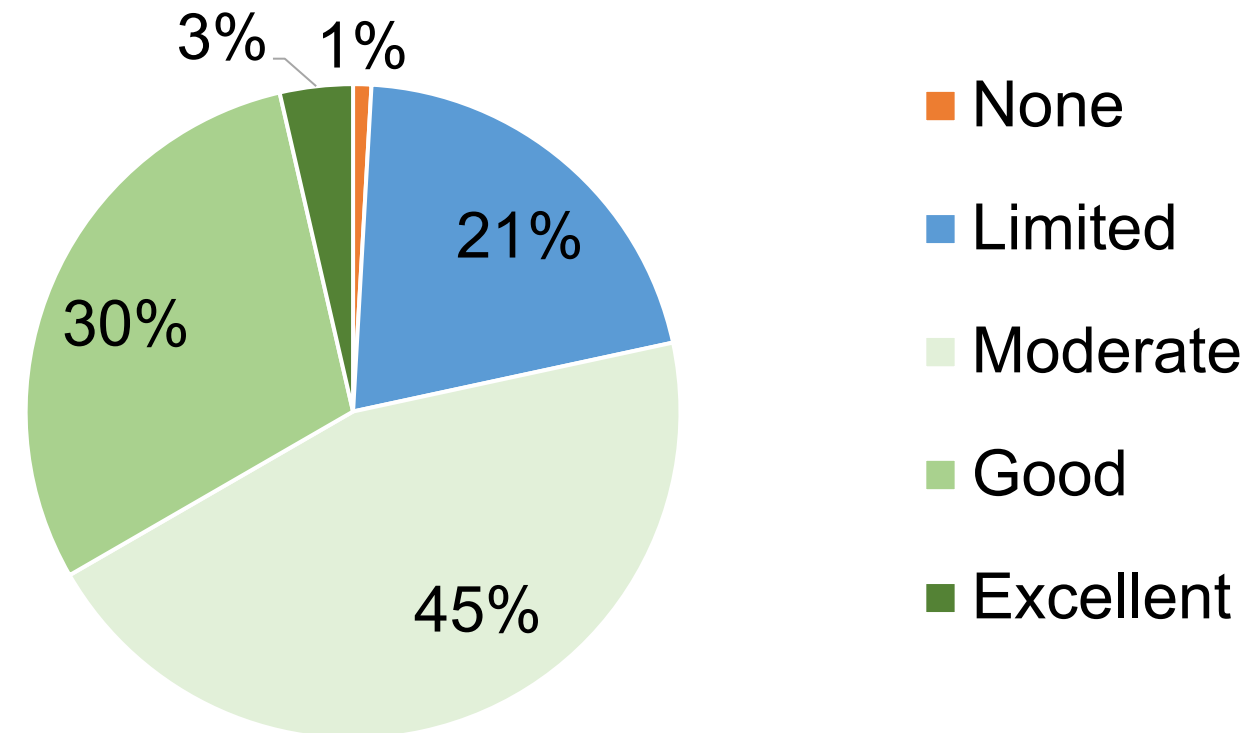


Google Forms

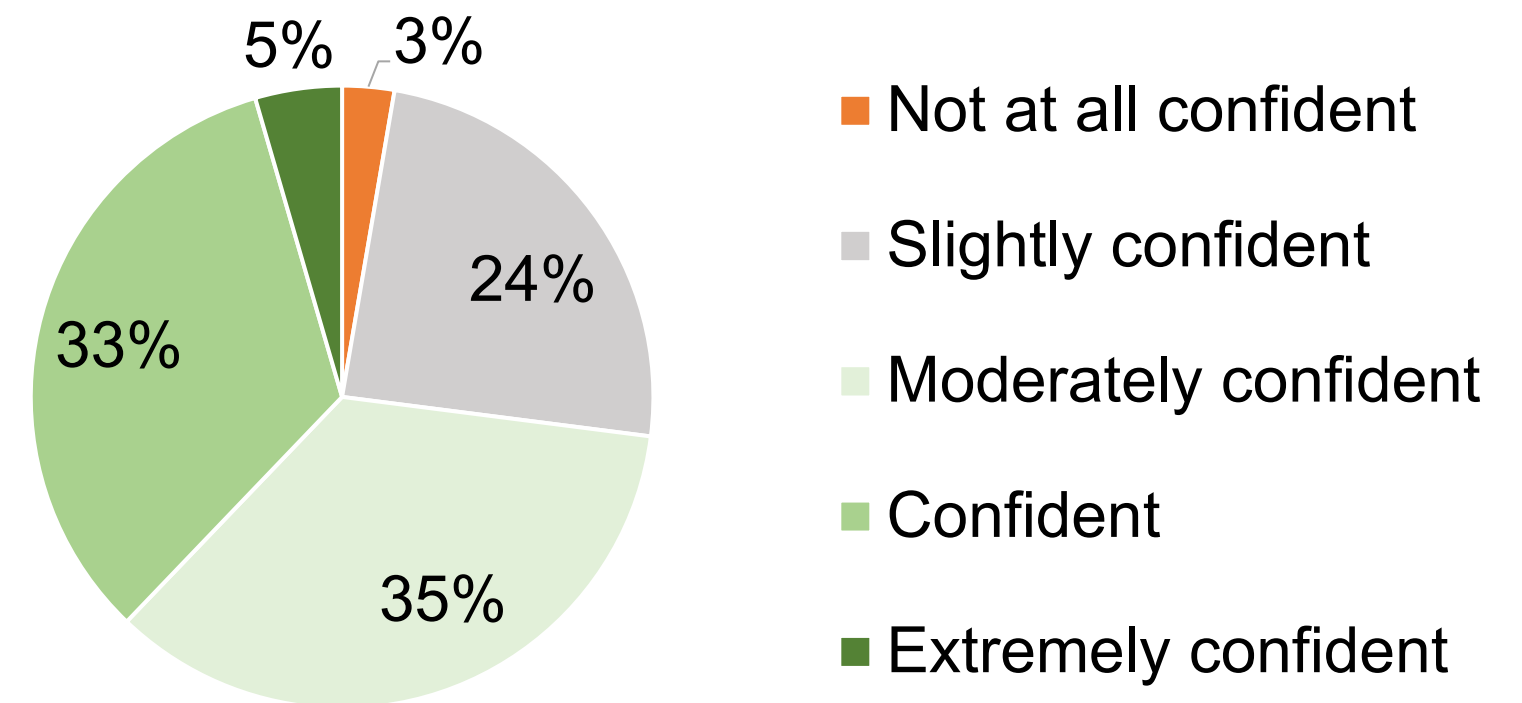
A screenshot of a Google Form interface. The first question is "How important do you think codes and specifications in engineering?" with a red asterisk indicating it is required. It has six radio button options: "I am not aware of civil or mechanical engineering codes and specifications", "Not important at all", "Not important", "Either important or not important", "Important", and "Very Important". The second question is "How often do you think engineers reference codes and specifications in their daily work?" also with a red asterisk. It has five radio button options: "Never", "Rarely", "Occasionally", "Frequently", and "Every day". The form is displayed within a light purple border.

Insights into Student Understanding and Confidence

What is your current understanding of industry standards and specifications in engineering?



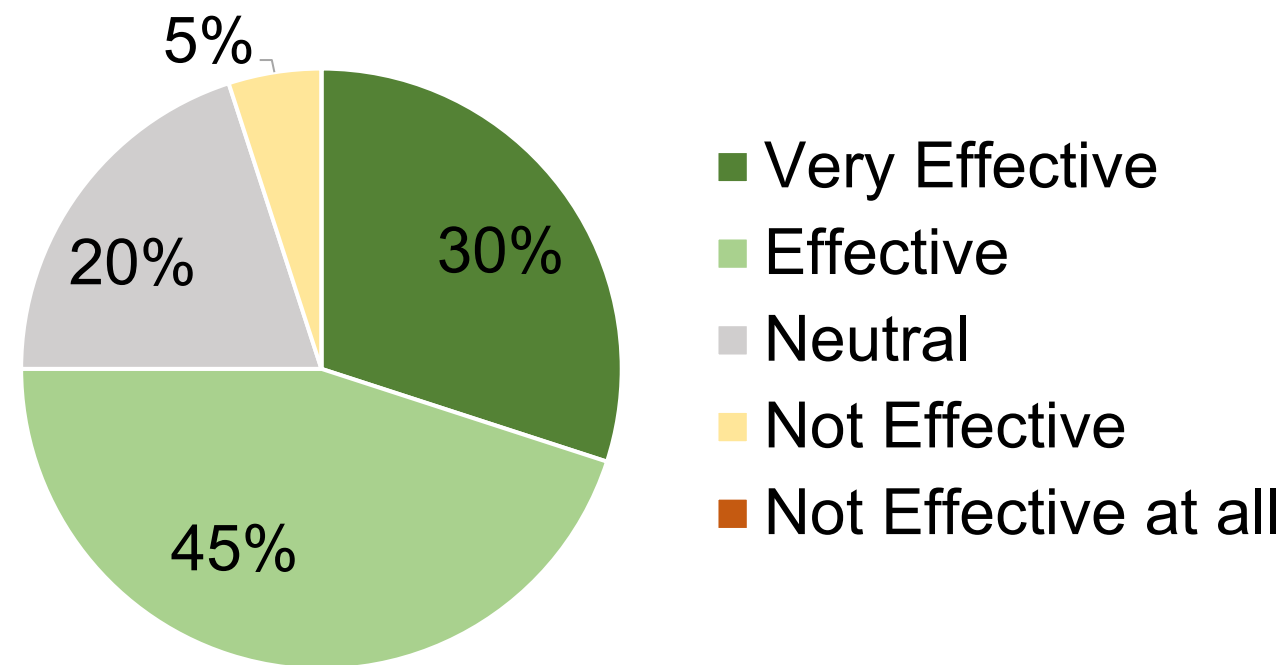
How confident do you feel in your ability to interpret and apply industry standards to real-world engineering problems?



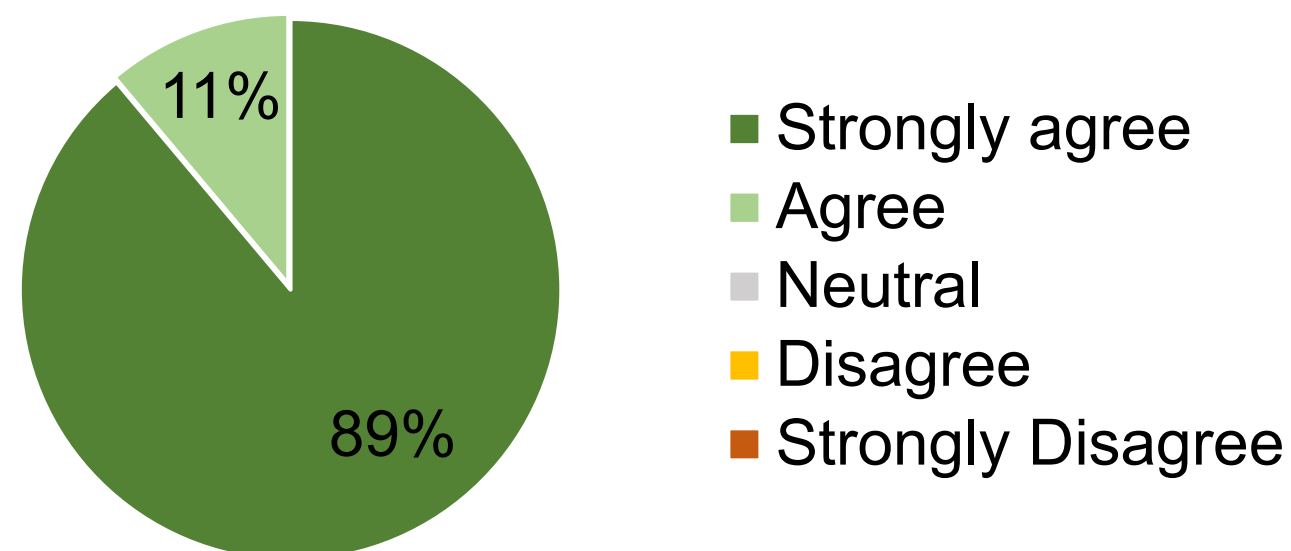
- These results suggest that the instructional modules and hands-on experiences have been **highly effective** in building both students' **understanding and confidence** in key areas of civil engineering practice.

Effectiveness of Modules Introduction to Civil Engineering

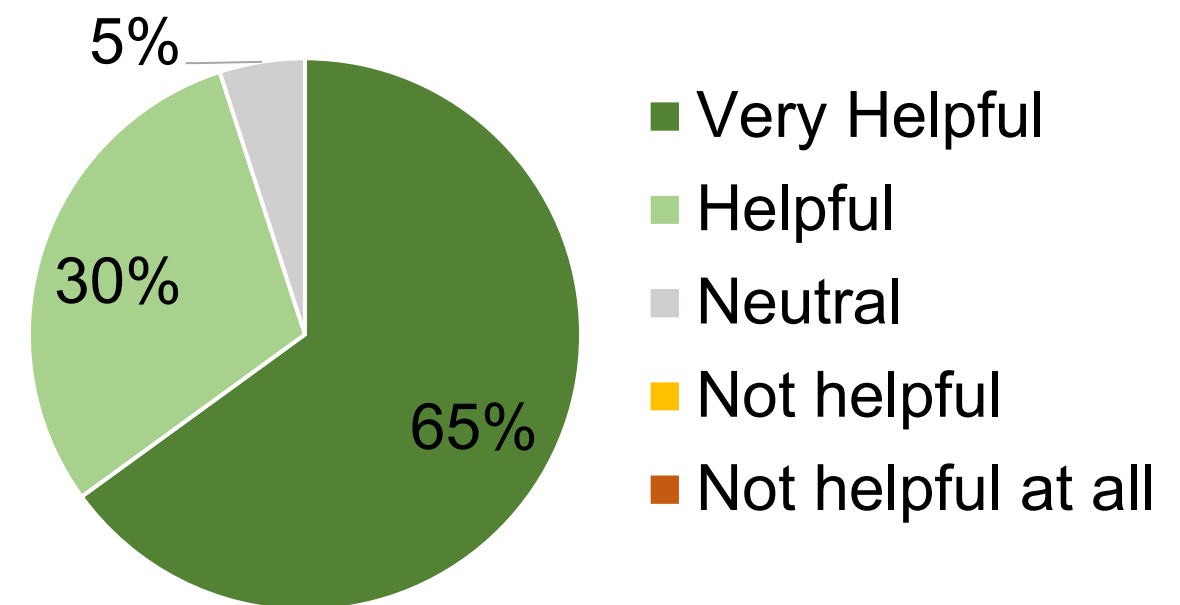
How effective do you think those two videos that help you understand NIST and differences between standards, codes, and specification?



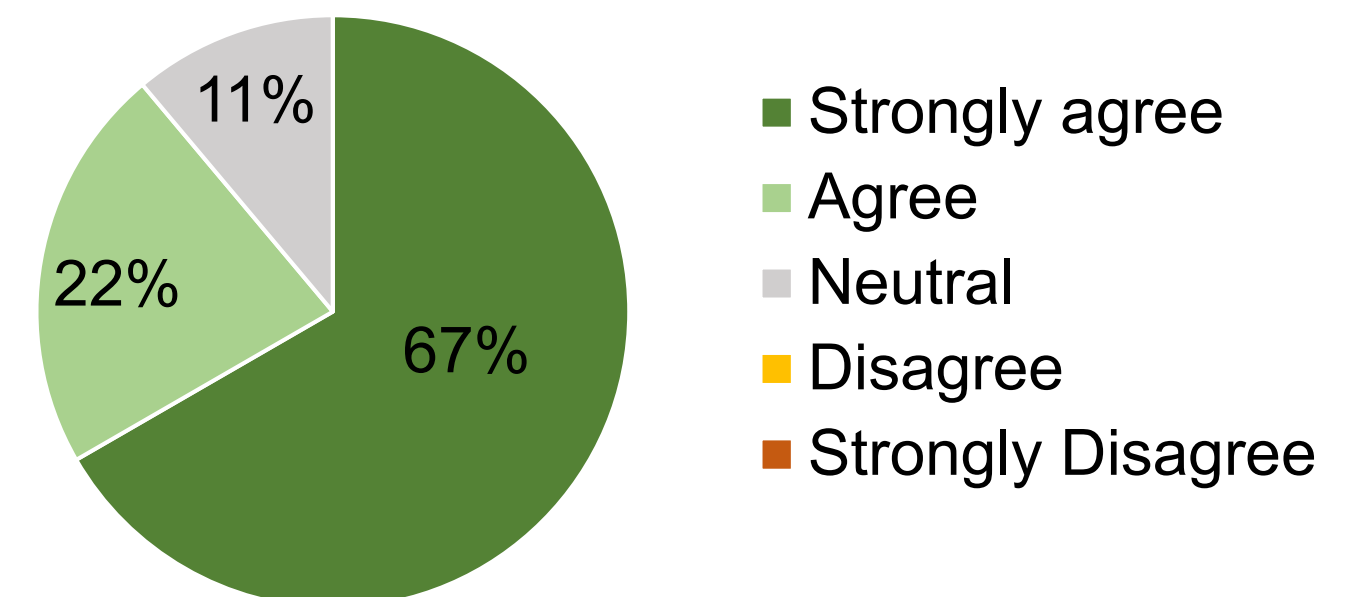
The field trip helped me connect classroom theory on standards, specifications, and codes with real-world civil engineering projects.



How did the project (blueprint reading, distance measurement and site verification activity) enhance your practical understanding of civil engineering specifications and standards?

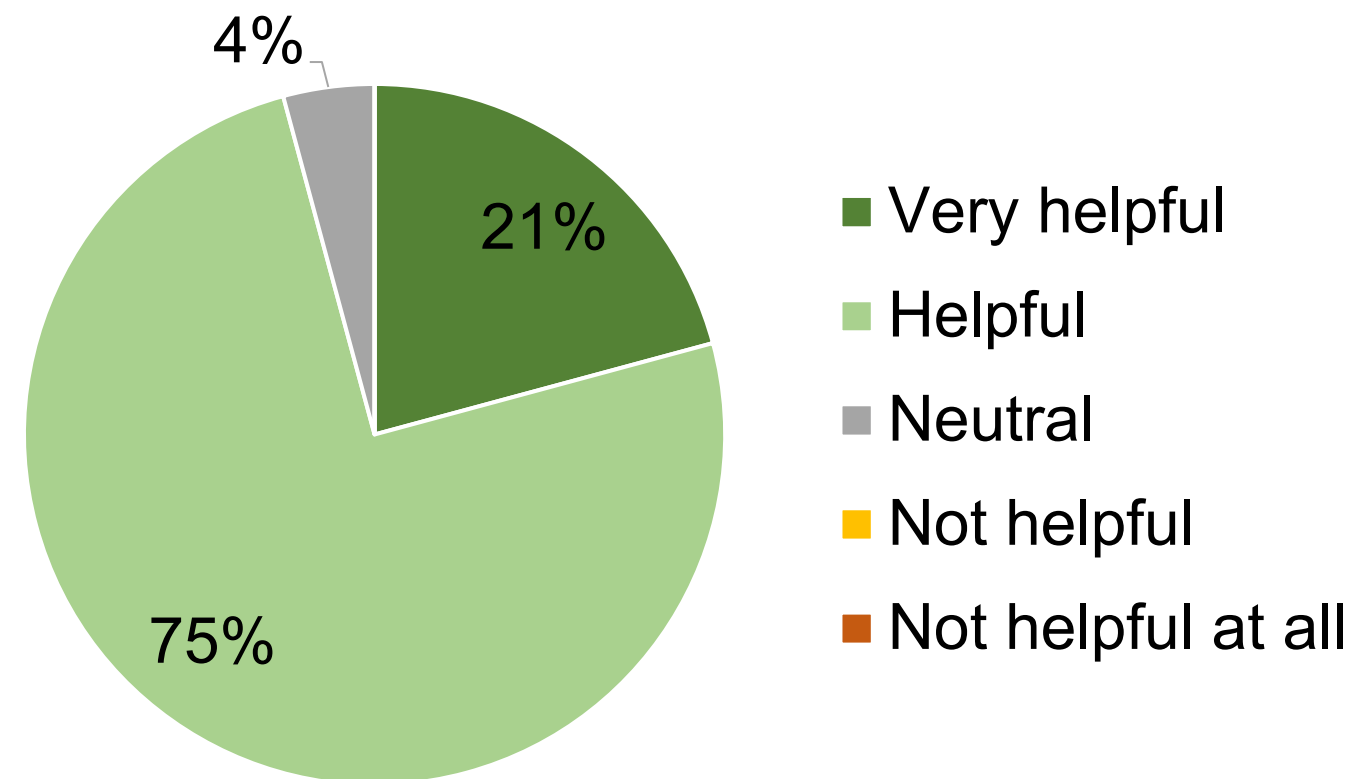


I am likely to use what I learned during the field trip in future civil engineering coursework or projects.

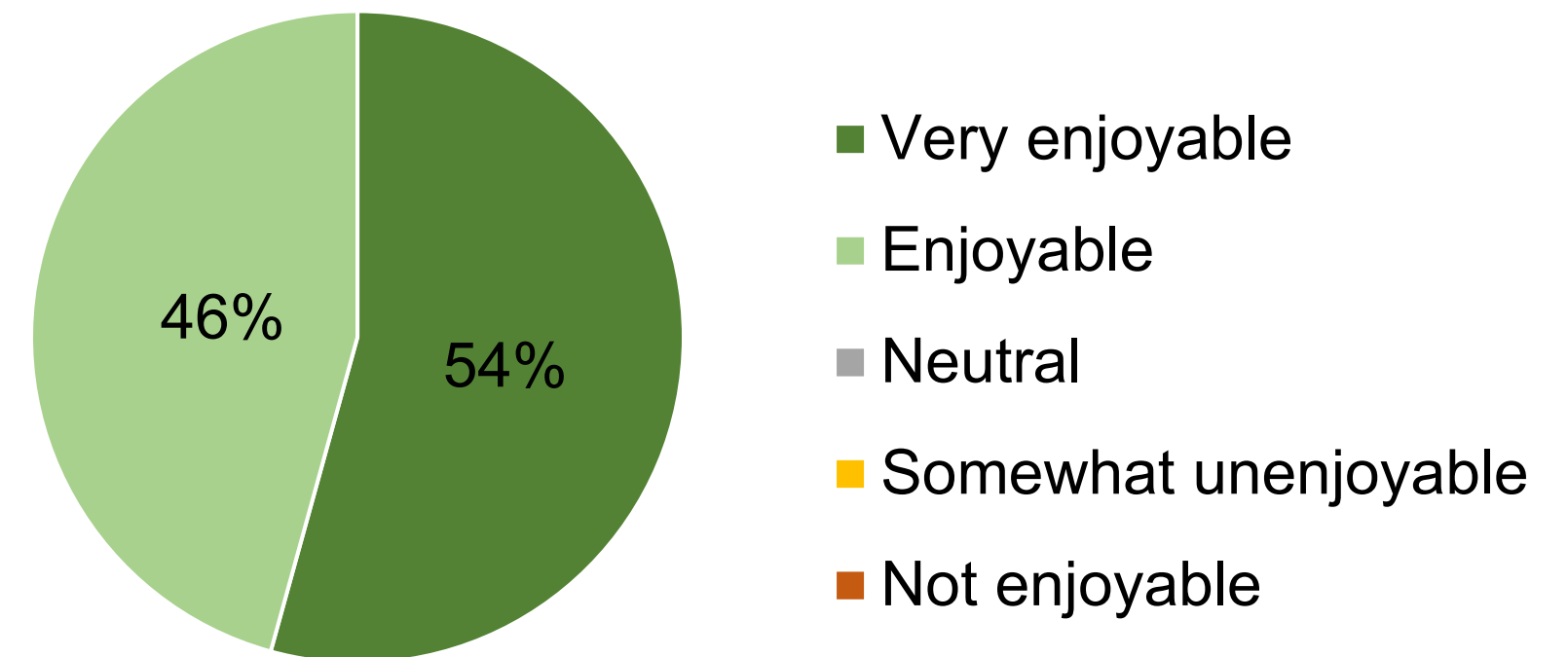


Effectiveness of Modules In Mechanics of Materials

How did the beam design project (using AISC Spreadsheet) enhance your practical understanding of civil engineering specifications and standards?



Overall, how would you rate the group activity?



- Students felt the project helped them **apply course knowledge to real-world situations**, and they were satisfied with their final scores.

EG315 Mechanics of Materials

- Team Project Survey Results

1. What do you like most about this project?

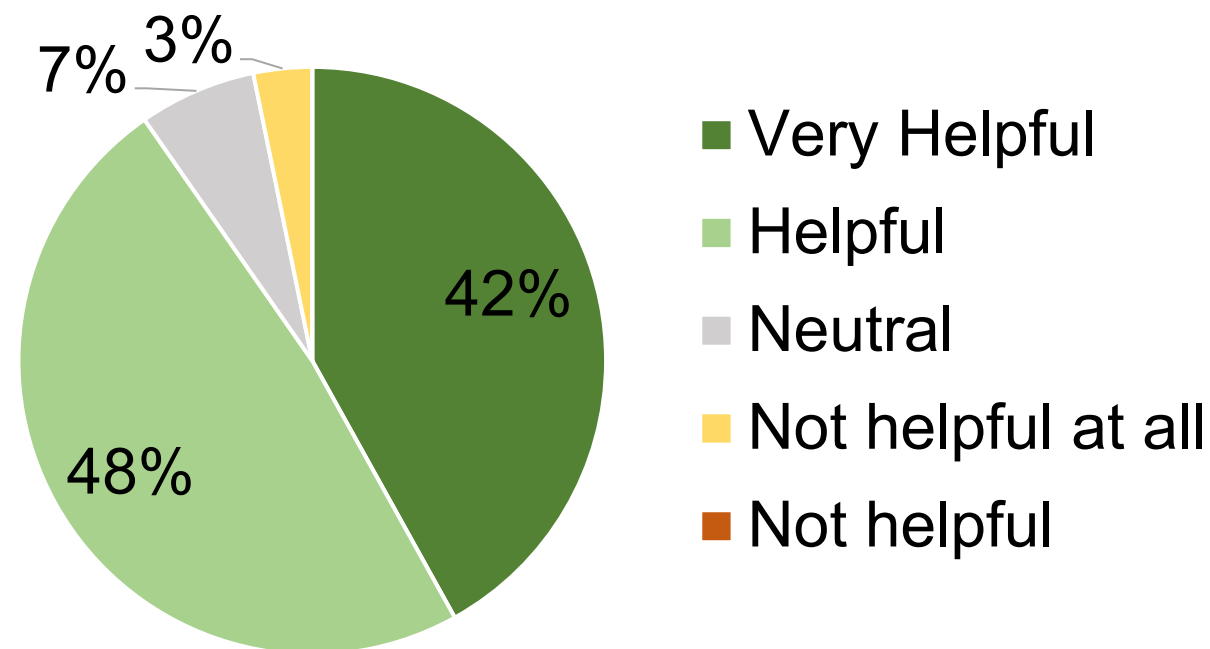
- Students appreciated **teamwork, collaboration, and applying class knowledge** to real-world problems.
- They valued the **clear structure, hands-on tasks, and the opportunity** to use engineering tools and concepts.

2. Has your team experienced any conflicts or issues? If yes, how were those conflicts or issues handled?

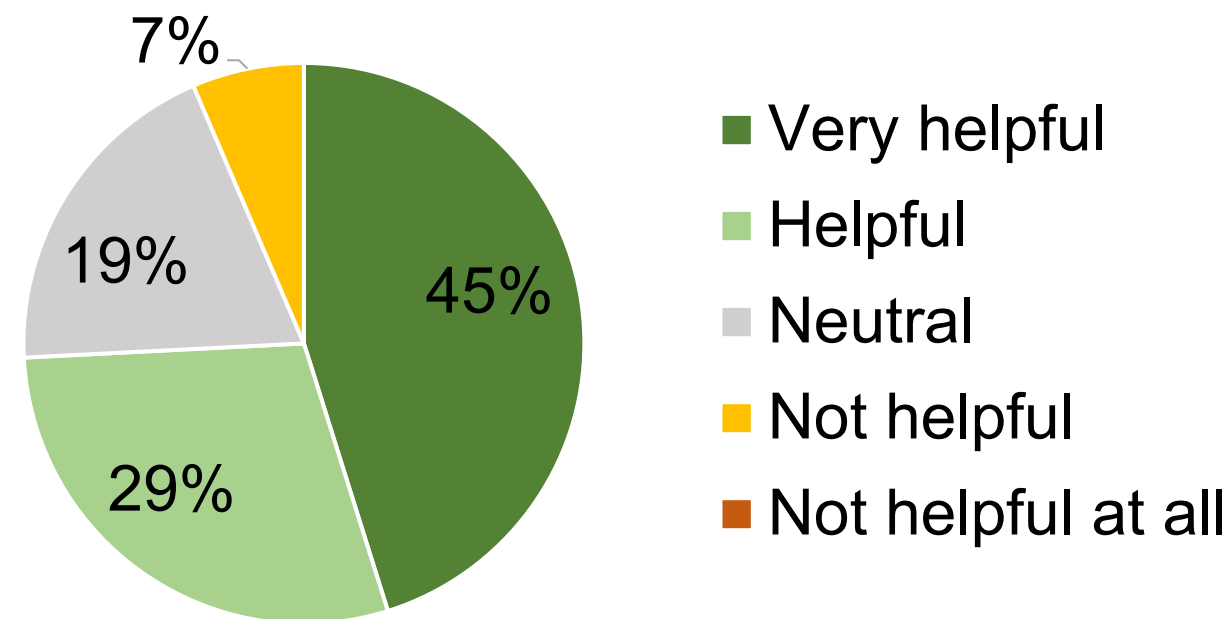
- Most teams reported few conflicts, mainly related to scheduling, participation, and incomplete tasks, which were resolved through collaboration, communication, compromise, and reassignment of work.

Effectiveness of Modules: Civil Engineering Materials & Lab

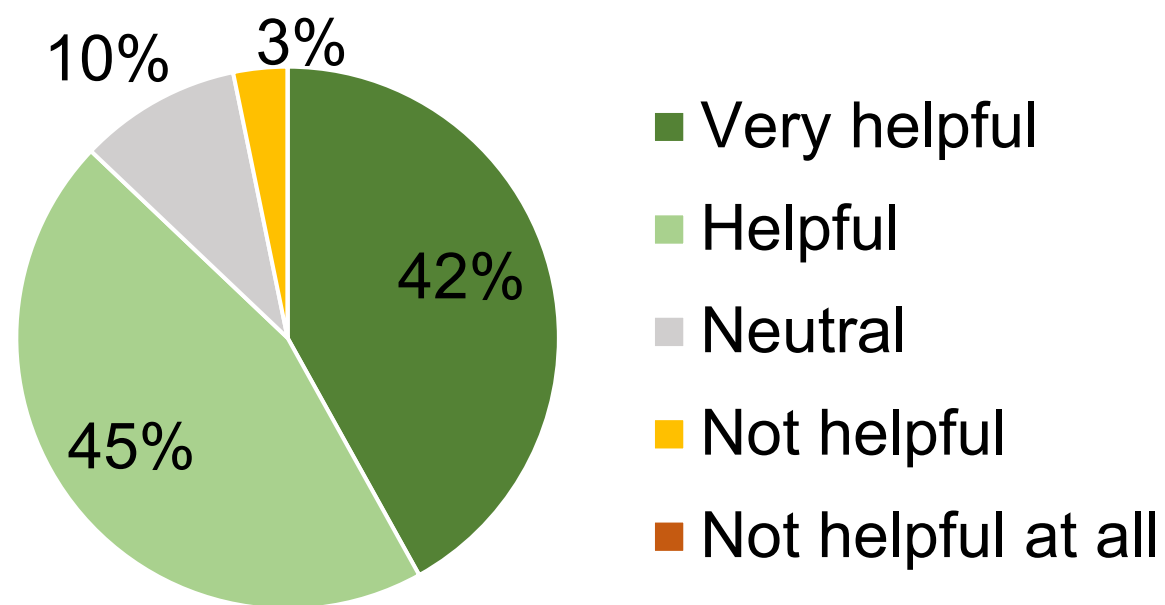
How did CE 315 lab activities (using AASTHO and ASTM) enhance your practical understanding of civil engineering specifications and standards?



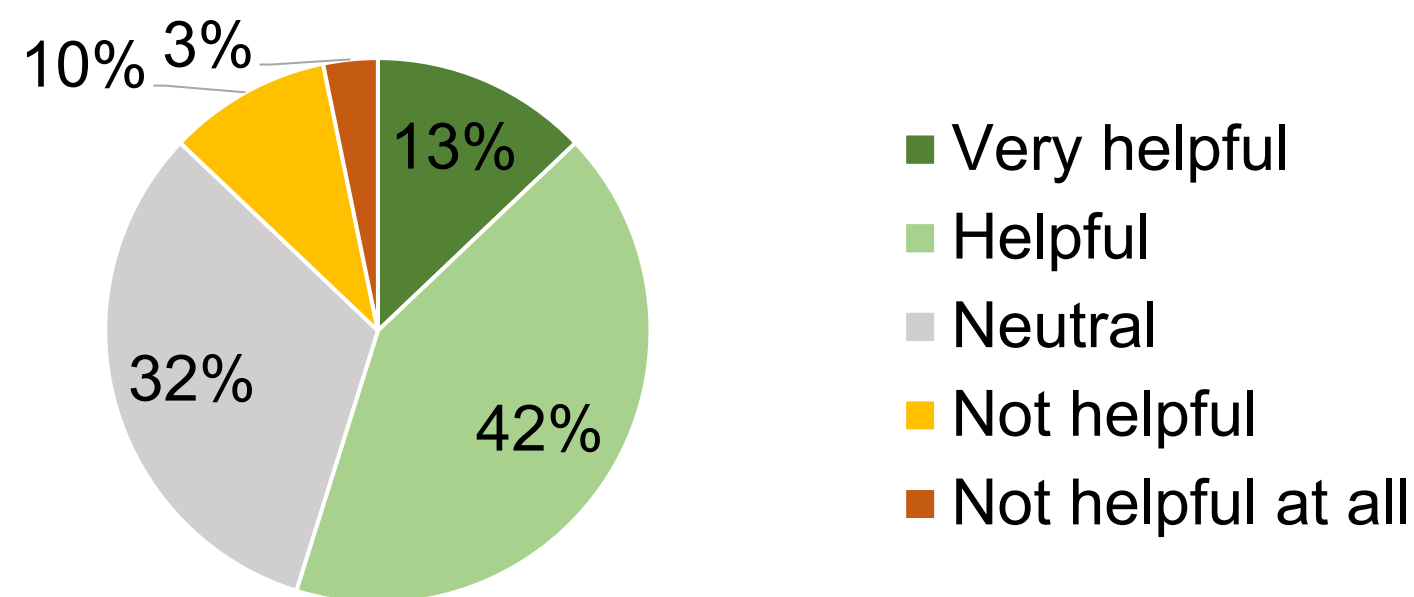
How did the CE 315 field trips (concrete plant and asphalt plant visits) enhance your practical understanding of civil engineering specifications and standards?



How did the CE 314 Guest Speakers (Cemex plant and asphalt plant visits) enhance your practical understanding of civil engineering specifications and standards?



How did the CE 315 Final Group Presentation enhance your practical understanding of civil engineering specifications and standards?



CE 590 Technical Writing for Research

Status of Students' Prepared Manuscripts

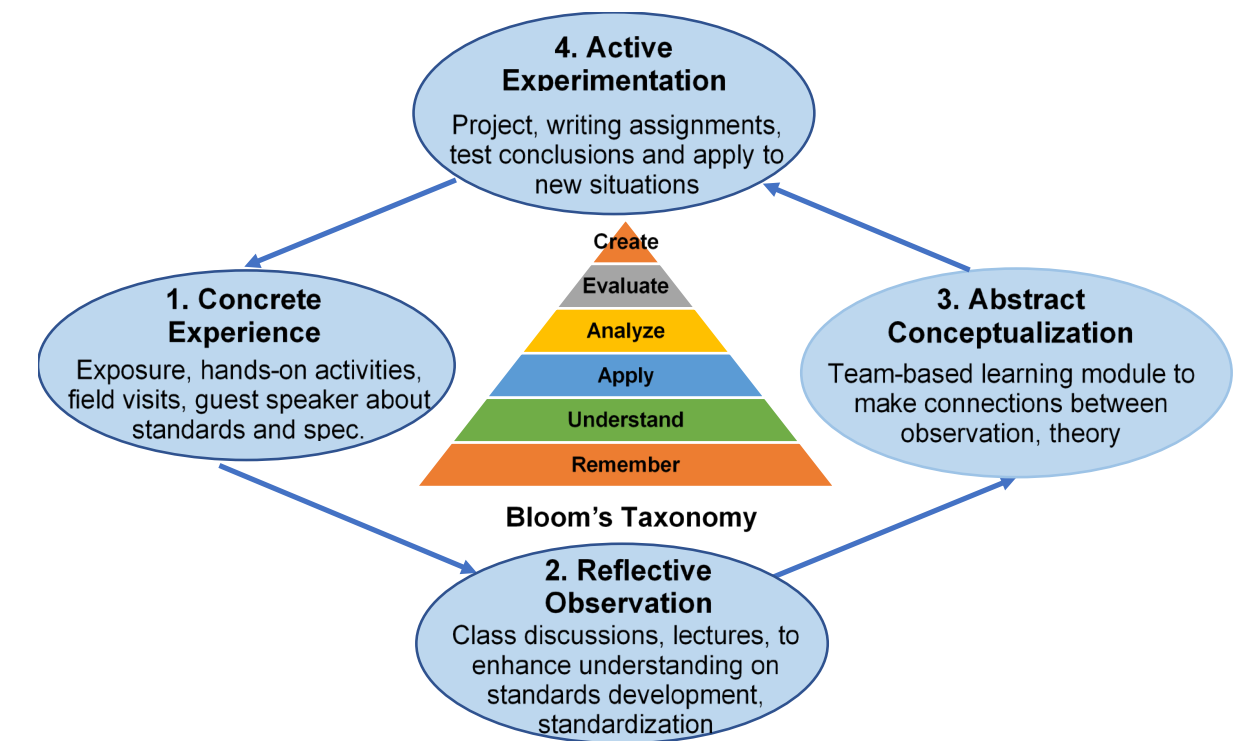
Student	Manuscript Title	Status
1	State of the Art Review on the Compatibility of Plastic Modified Asphalt	Published
2	A Comprehensive Study on the Use of Rejuvenator in Asphalt Pavement	Published
3	AI-based Techniques For Flood Management: a Comprehensive Review	Not submitted
4	State of Art Review on Arsenic Removal from Stormwater using Adsorbents	Not submitted
5	The Impact of microplastics and nanoplastics on Marine Ecosystems and Human Health: A Comprehensive Review	Submitted, under review
6	Nanoplastics: Environmental Presence, Ecological Implications, and Mitigation Approaches	Published
7	Engineering Countermeasures for Red Light Running: A State-of-the-Art Review	Published
8	Avancement of Research on Impacting Factors and Countermeasures Related to Dilemma Zone Crashes: A State-of-the-art Review	Published
9	A State of the Art: Resilience of Concrete Pavement with Climate Change	Submitted, under review
10	A Comprehensive Review of Moisture Damage in Asphalt Mixtures: Mechanisms, Evaluation Methods, and Mitigation Strategies	Published
11	State of Art Review on Litter Collection on Road Side	Not submitted
12	Decentralized Wastewater Treatment System: A Review	Not submitted
13	Phosphorus Removal and Recovery from Stormwater: A Review	Submitted, under review

Out of 13 students:

- 6 published/accepted
- 3 submitted/under review
- 4 not submitted

Conclusions

This pilot study employed the **experiential learning model** and **Bloom's taxonomy** to design flexible modules that can be seamlessly integrated into the existing civil engineering curriculum.



- The Introduction to Civil Engineering course effectively introduced students to standards, codes, and specifications **through hands-on activities** such as blueprint reading, CAD redrawing, 3D modeling, and field trips. These activities bridged the gap between civil engineering theory and practice, with 75% of students reporting that the tasks were “helpful” or “very helpful” in enhancing their **understanding and confidence in applying standards**.
- In the Mechanics of Materials course, the beam design project guided by AISC standards enhanced students’ ability to analyze and design structural components, with 96% reporting **improved understanding and confidence in applying standards**.
- The Civil Engineering Materials and Lab course provided **hands-on experience through ASTM and AASHTO lab tests, field trips** to material production plants, and guest lectures, resulting in 90% of students gaining a **deeper understanding and practical skills in real-world applications**.

Dissemination

- ASEE Annual Conference 2025, ASEE Southeastern Conference 2025, ASEE Annual Conference 2024
- Conference of Teaching and Learning (CoTL) 2025, 2024



Paper ID #45501

Case Study of Integrating Standards, Codes, and Specifications into Engineering Curricula: Various Pathways to Professional Readiness

Dr. Shenghua Wu, University of South Alabama

Dr. Shenghua Wu is an Associate Professor in the Department of Civil, Coastal, and Environmental Engineering at the University of South Alabama. His research areas include civil engineering materials characterization, pavement performance evaluation and modeling, design, and maintenance, multidisciplinary approach to address complex engineering issues, as well as STEM education. He holds multiple leadership roles, including the Director for Interdisciplinary Center for Sustainable Engineering (ICSE), Executive Director for Gulf Coast Environmental Equity Center (GCEEC), Director for the Solid Waste Sustainability Hub, Director for the Gulf Coast Center for Addressing Microplastics Pollution (GC-CAMP), and Director for the Sustainable Asphalt Materials Laboratory, as well as the founding faculty advisor for the Society of Sustainable Engineering. He teaches a mixture of undergraduate and graduate engineering courses. Dr. Wu is a committee member for Transportation Research Board (TRB) AJE35 and AKM 90, a member of American Society of Civil Engineer (ASCE), American Society for Testing and Materials (ASTM), and Academy of Pavement Science and Engineering (APSE), as well as an editorial member for Journal of Testing and Evaluation and International Journal of Pavement Research and Technology. He serves panel member for several NCHRP and ACRP projects. He is also a registered professional engineer in Alabama and LEED AP.

Dr. Min-Wook Kang, University of South Alabama

Dr. Kang is a professor of Civil, Coastal, and Environmental Engineering at the University of South Alabama

Dr. John Cleary, University of South Alabama



Paper ID #45500

Fast-Track to Research Writing Mastery: A 9-Week Intensive Course for Graduate Students

Dr. Shenghua Wu, University of South Alabama

Dr. Shenghua Wu is an Associate Professor in the Department of Civil, Coastal, and Environmental Engineering at the University of South Alabama. His research areas include civil engineering materials characterization, pavement performance evaluation and modeling, design, and maintenance, multidisciplinary approach to address complex engineering issues, as well as STEM education. He holds multiple leadership roles, including the Director for Interdisciplinary Center for Sustainable Engineering (ICSE), Executive Director for Gulf Coast Environmental Equity Center (GCEEC), Director for the Solid Waste Sustainability Hub, Director for the Gulf Coast Center for Addressing Microplastics Pollution (GC-CAMP), and Director for the Sustainable Asphalt Materials Laboratory, as well as the founding faculty advisor for the Society of Sustainable Engineering. He teaches a mixture of undergraduate and graduate engineering courses. Dr. Wu is a committee member for Transportation Research Board (TRB) AJE35 and AKM 90, a member of American Society of Civil Engineer (ASCE), American Society for Testing and Materials (ASTM), and Academy of Pavement Science and Engineering (APSE), as well as an editorial member for Journal of Testing and Evaluation and International Journal of Pavement Research and Technology. He serves panel member for several NCHRP and ACRP projects. He is also a registered professional engineer in Alabama and LEED AP.

Min-Wook Kang, University of South Alabama

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Dr. John Cleary, University of South Alabama
Lisa LaCross, University of South Alabama



Fostering Student Ownership and Active Learning through Student-Led Group Lectures in a Civil Engineering Materials Course

Dr. Shenghua Wu, University of South Alabama

Dr. Shenghua Wu is currently an Associate Professor in the Department of Civil, Coastal, and Environmental Engineering at the University of South Alabama. His research areas include civil engineering materials characterization, pavement performance evaluation and modeling, design, and maintenance, multidisciplinary approach to address complex engineering issues, as well as STEM education. He is the Director for the Solid Waste Sustainability Hub, Gulf Coast Center for Addressing Microplastic Pollution (GC-CAM), and the founding faculty advisor for the Society of Sustainable Engineering. He teaches a mixture of undergraduate and graduate engineering courses. Dr. Wu is a committee member for Transportation Research Board (TRB) AJE35 and AKM 90, a member of American Society of Civil Engineer (ASCE), American Society for Testing and Materials (ASTM), and Academy of Pavement Science and Engineering (APSE), as well as an editorial member for Journal of Testing and Evaluation and International Journal of Pavement Research and Technology. He serves panel member for several NCHRP and ACRP projects. He is also a registered professional engineer in Alabama and LEED AP.

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Moving Forward

- **Enhance Experiential Learning Opportunities**
 - 2025 Fall Semester and 2026 Spring
- **Address Key Challenges**
 - Improve access to code resources (databases, websites)
 - Clarify technical language and terminology
 - Guidance on navigating extensive specification, standards, and codes documents
- **Curriculum Integration**
 - Integrate standards education into technical elective courses
 - Disseminate the results and foster collaborative environment within the department, college, and beyond
 - Assess students' learning outcomes and program success

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Thank you! Questions?
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<https://sites.google.com/southalabama.edu/standards-education/>