Program-Level Assessment: Annual Report

Program Name (no acronyms): Mechanical Engineering	Department: Aerospace & Mechanical Engineering
Degree or Certificate Level: BS	College/School: School of Science & Engineering

1.

For all artifacts, the summary of the course assessment is presented to the department when the outcome is collectively reviewed and can undergo further review at that time.

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off campus sites)?

Outcome 1

MENG 2150 – Across two semesters, 17 of 24 mechanical engineering students at least met expectations and of those 2 exceeded expectations. This was just at the target level of 70% at least meeting expectations. Those who did not meet expectations generally had difficulties setting up the proper equations and the subsequent mathematics.

MENG 3200 – In the semester reviewed, 7 of 19 mechanical engineering students exceeded expectations, 6 met expectations, and 6 did not meet expectations. This was just below (68%) the desired level of 70% met/exceed expectations. Primary issues were proper equation set up and mathematical errors. The math level was more at a high school level than college (trig, algebra), so the number of errors of this type were concerning. Possibly connected to COVID issues or time pressures.

MENG 4400 – One semester, 6 of 9 mechanical engineering students at least met expectations of at least a 70% class grade, with 3 identified as exceeding expectations. This is just below (67%) the goal of 70% of students at least meeting expectations. Choosing the proper equation set up and vector math errors were the primary issues along with time constraints. Note that the number of students reviewed is less than 10 to make any strong conclusions.

Outcome 3

MENG 1000 – Based on data from Spring 2022 and Spring 2023, all 20 teams consisting of 77 students met or exceeded expectations and 31 students exceeded expectations. Madrid across 2021 and 2022 saw seven of nine students met or exceed expectations with three of the four mechanical engineering students doing so based on project portfolio development and a presentation.

MENG 3201 – Based on data from one section in Fall 2022, three of 14 students did not meet expectations and 79% of students did, exceeding the goal of 70% meeting or exceeding expectations. The greatest weaknesses were in the ability to properly organize the information in a lab report and to communicate technical concepts in figures and written communication.

MENG 4014 – 34 of 37 students in six teams met or exceeded the class communication participation requirement while all teams and students met the presentation and written report expectations. The students that did not meet the class participation expectations were allnoro(r)3.2 (eq4(o)-9p)-0.7 (r)-gl 0]TJ -– 216.1 (e0.6)11 ( ]TJ -)Tj 0.5 0

- Students had trouble with pre-req material (Math & Physics) and were not well prepared. These concepts were re-taught in the dynamics and fluid dynamics courses.

7.

AEME ABET Assessment Review Form

This form is a summary of the collective departmental review of learning outcome assessment, to be used to record review group thoughts about assessment materials collected.

Program (AE or ME): ME Date materials reviewed: 04/24/2023, 05/10/2023

Criterion reviewed (circle one): 1 2 3 4 5 6 7

an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Semester(s) reviewed: Fall 2022 (primarily)

Reviewers: Alexander, Condoor, Gururajan, Jayaram, LeBeau, Lei, Marmolejo, McQuilling, Swartwout

Courses and instruments:

Course	Semester	Description (ind/Grp)	Level	Math	Sci	Cplx
MENG 2150	AE (S) ME (F)	Final Exam problem on energy/work/kinematics in a system (Individual)	Early Formative	N	N	N
MENG 3200	AE (S) ME (F)	Ind Exam Problem 2D C mass/momentum, dimensionless analysis	Middle Formative	N	N	N
MENG 4300	ME (S)	Examination Problem: Combined Conduction and Natural Convection (Individual)	Late Summative	N	?	?

Strengths and weaknesses:

Mechanical students had 14 of 19 students meet or exceed expectations in MENG 2150 Dynamics and 13 or 19 do so in MENG 3200 Fluid Dynamics. These scores are around the desired 70% meets or better standard, with Dynamics just above and Fluid Dynamics just below.

General observations on student preparedness including math and science knowledge retained from the first year of college. Several faculty found the need to re-teach concepts that are supposed to have been learned in prerequisite courses.

Recommendations and proposed actions:

Develop specific assessment instruments for MENG 4300 Heat Transfer (Marmolejo) (This was done in the spring semester)

Monitor ME student performance in Fluid Dynamics during spring semester to see if issues continue with increased sample size.

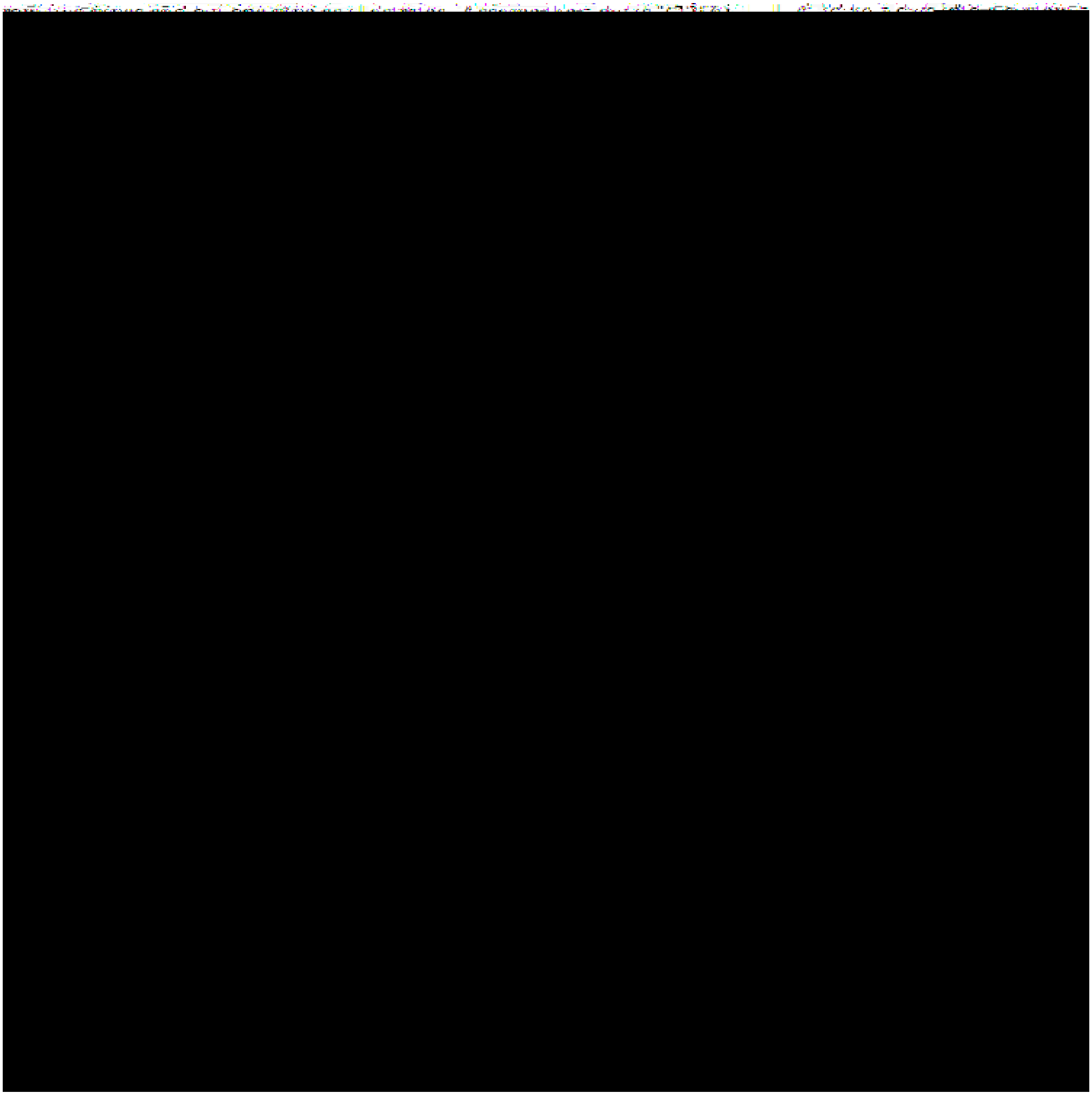
Review prerequisite requirements, increase documentation of expectations from prerequisite courses including physics, math courses.

Other comments: This was the first review of this outcome under the newly revised assessment plan of August 2022.

Learning Outcome:	1 (Solve Problems using SEM)	2 (Design in Global Context)	3 (Effective Communication)
[select 1]	4 (Ethics in Global Context)	5 (Functional Teamwork)	6 (Experiment and Draw Conclusions)

This approach provided a clear framework for evaluating student performance and determining their level of

A score below 60% was treated as automatically Below Expectations, Above 87% was considered automatically Above Expectations. Between was an assessment of the nature of the errors and how it fit in the rubric above, with all three categories possible.



Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 4300 (Heat Transfer)

Location in Program Early Middle End

An ability to identify, formulate, and solve complex engineering problems by applying principles of engineerin science, and mathematics.

Instrument: Examination Problem: Combined Conduction and Natural Convection

Methodology: The exam problem (included) is graded by the instructor. Assessment is based on the performance in solving the problem and the rubric. The instructor can provide a more precise interpretation of the rubric for this specific problem.

Rubric See rubric below.

Desired result: Achieve a minimum of 70% of students scoring "Meets" or "Above Expectations."

Students assessed: This assessment focuses on the 9 students majoring in mechanical engineering out of a total class size of 28 students. The remaining students were majoring in aerospace engv Td [( )6 ( )]TJ1 (e)- [(e)-1 (n)-4of ay -1 (hi)-7e tu -g tudult s o -v.vn8 (eg)710 (r (g).11

Firstly, consider redesigning this assessment as a stand-alone exam or quiz, allowing students ample time to complete the problem. This adjustment acknowledges the complexity of the assessment and ensures students have the necessary time to demonstrate their understanding.

Secondly, allocating more time for and providing additional practice problems with combined elements (conduction-convection-radiation) is essential. This can be achieved through the inclusion of hands-on exercises, experiments, or integrating Matlab usage into homework problems, as the nature of these problem solutions can be intricate.

Moreover, a continuous evaluation of student performance and ongoing improvement efforts will be crucial in maintaining and elevating the program to meet the desired standards in the long term.

Additionally, considering a tracking system to gauge students' understanding of fundamental concepts from previous thermal-related courses could provide timely support to those struggling with basic concepts. This proactive approach aims to address foundational knowledge gaps and facilitate overall student success.

Indicator	Below Expectations	t-w 1mg0.1 t-w 1mg0.1

Mechanical
Engineering

This approach provided a clear framework for evaluating student performance and determining their level of achievement based on the established criteria. It allowed for a comprehensive assessment that considered both numerical scores and qualitative analysis, taking into account the specific errors made and their alignment with the performance expectations outlined in the rubric.

Problem 8

the wall temperature at $x = t$, T_s, is 350°C. A ... natural convection between the internal wall and hot air. Neglect heat transfer by radiation. Consider the walls of the oven as ... vertical brick walls of 50 mm thickness and 30 cm tall (k_{brick} = 0.75 W/m²K) *Hint: you need to solve an ODE.

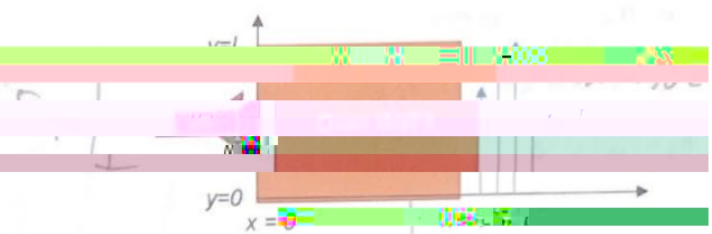
For air at 400 C

k = 0.05015 W/mK

cp = 1069 kJ/kgC

Pr = 0.69

$\nu = 6.219 \times 10^{-5}$ m²/s



AEME ABET Assessment Review Form

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Program (AE or ME): ME   Date materials reviewed: 05/10/2023

Criterion reviewed (circle one): 1 2 3 4 5 6 7

an ability to communicate effectively with a range of audiences

Semester(s) reviewed: Fall 2022 (primarily)

Reviewers: Alexander, Condoor, Gururajan, Jayaram, LeBeau, Lei, Marmolejo, McQuilling, Swartwout

Courses and instruments:

Course	Semester	Description (ind/Grp)	Level	Type	Audience
MENG 1000	ME (S)	Project presentation and report, small teams	Early Formative	Oral, Written	
MENG 3201/MENG 3111	ME (F) AE (S); ME (S), AE (F)	Formal Lab Report, individua	Middle Formative	Written	Technical
MENG 4014	ME (S)	Final Presentation (group), Final Report (group)	Late Summative	Oral, Written	Professional, Technical

Strengths and weaknesses:

Students need improved technical writing skills as opposed to general writing skills –

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 1000 (Design Thinking) (Spring 2022)

Location in Program: Early Middle End

Method: A project was assigned to the class and used to demonstrate written and oral communication skills.

Rubric: A panel of judges evaluated the project report and technical presentation. For the report, three TAs and the instructor evaluated the outcome. Three faculty members and three TAs reviewed the presentation.

Desired result: 80% of students will meet expectations

Student performance: 100% of the students (31 out of 31) met expectations. 16 students (52% of students far exceed expectations, 48% exceed expectations)

Observations

Program Assessment: All Student teams did well in delivering their projects' written reports. The student presentation skills were good. Judges' felt that the visual elements can be improved.

Action: Incorporate a module on presentation skills.

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 1000 (Design Thinking) (spring 2023)

Location in Program Early Middle End

Method: A project was assigne :Td [9e Td [9e7n>h(s)2 .1 (e) c(m)2.8loe oma

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 1000 Design Thinking

Location in Program: Early Middle End

Learning Outcome 1: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic facto

Instrument: Final Design Thinking Project

Methodology: Create a complete design thinking project portfolio using a certain number of Design Thinking tools that are presented gradually in class.

Rubric: See rubric below.

Desired result: 80% of students scoring Meets or Above Expectations

Students assessed: The sample consisted of 9 students, across two different academic years (2021 2022), 4 majoring in Mechanical Engineering, 2 in Graphical Design (visiting students from another institution) and 1 undecided major.

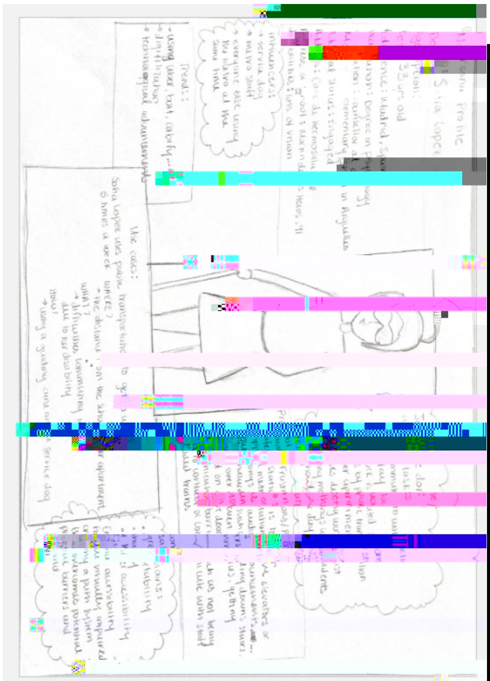
Student performance: 7 students meet or exceeded expectations, 2 students did not meet expectations.

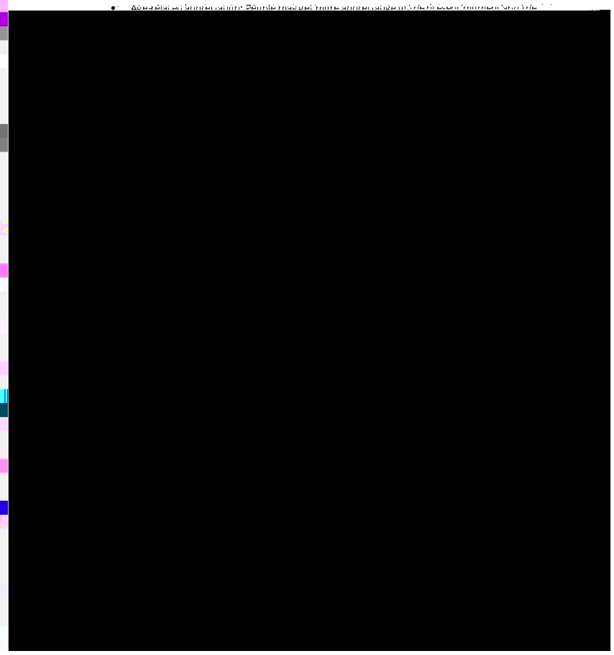
Observations: Common errors were a failure to apply a deep enough design thinking analysis or very shallow applications of specific tools.

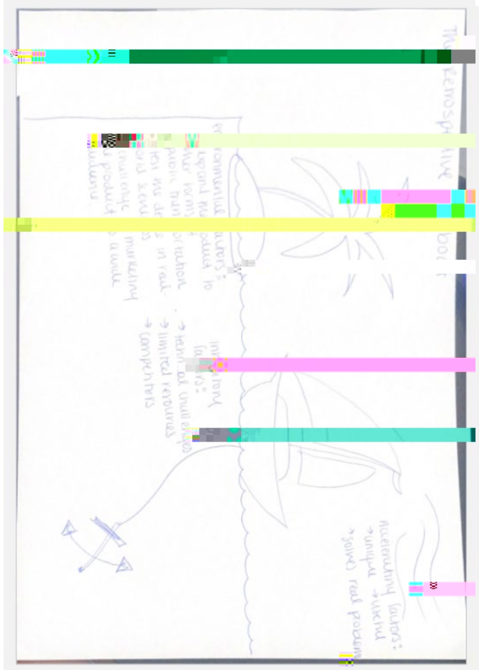
Assessment: 70% of the mechanical engineering students met or exceeded expectations.

Proposed Action: This SLO shows that expectations for design outcome are met satisfactorily in MENG1000.

Indicator	Below Expectations	Meets Expectations	Above Expectations
Ability to create a full design thinking portfolio for a new product or service.	Student fails to produce a portfolio with the sufficient number of tools or the use of each tool is shallow and does not answer the required questions.	Student produces a report that meets more than 70% of the required tooling use.	Student produces a report fulfilling all the requirements and uses all the presented tools in depth.
Ability to create a design thinking project portfolio report.	Student fails to produce a project report detailing the design thinking process.	Student report contains t 70% of the required elements of the project.	Student report contains 100% of the elements of the project or 80% of the elements at an additionalrte -(1)2. level of analysis.








Define the Point of View
Vision Cone
Public Transport
NOW
Citizen
CLEAN
FAST

Observations: The reports were generally followable and conveyed the information presented reasonably well. Numerous students presented incomplete or not well constructed tables and/or plots. Most students had the appropriate sections, but a common error was either putting analysis/calculations into the Results or failing to include some text explanation and just dumping it all in the appendix. Spelling and grammar errors were uncommon (although Reynold's appeared in several papers) and were most prominent in the Summary and Introduction sections.

Assessment The average shows three students scoring below 2, or 70% meeting/exceeding expectations. By indicator, the worst performances were Indicators 1 and 2, both at 86% meets or exceeds. Four students (with scores above 2.5/3) may be considered to have exceeded expectations.

Proposed Action: The lab course is phasing out, but this lab is likely to remain a key lab in the new Mechanics Lab. The lab does not take long to complete, so there is time for increased instruction by the TA running the lab. However, both the TA's and the students need more clarity about the expectations for the lab, and students need more and better feedback on their writing from earlier labs. It is not clear that undergraduate TA's are sufficient for this task, although more instruction for them might help as well. The reduction of the number of TA's from 4 to 2 also impacts the results from this lab.

Specific steps may be:

1) Provide a sample lab write up based on a lab being phased out of ESCI 3201 or a lab that do not require a report. This is mainly to act as a template.
2) Create more detailed solution data and expectations for each lab section for the teaching assistants, particularly regarding this outcome.
3) Have the instructor provide feedback based on this rubric in an earlier group lab to assist both the students and the TA's in understanding expectations.

Indicator	Below Expectations	Meets Expectations	Above Expectations
1) Ability to communicate in an orderly and complete manner.	Sections of the lab report are absent and/or hav A2f th A2avt an an-11 (u)2.3 (n)2		

		structure is not well-organized or lacks sufficient clarity.	the report.

FLAT PLATE BOUNDARY LAYERS

OBJECTIVE

In this lab you will learn methods to:

- Measure flat plate boundary layer velocity profiles under laminar and turbulent conditions
- Compare velocity profile measurements to accepted theoretical values

INTRODUCTION

Flow in contact with a wall is assumed to match the velocity of the wall (no slip condition). Thus moving away from the wall, the fluid must transition from the velocity of the wall to the velocity of the freestream, which is the primary flow velocity. This creates a region called the boundary layer in which the flow speed is between the wall and the freestream. The thickness of the boundary layer is often labeled as δ. In the case of flow over a stationary flat plate, this thickness increases as the flow moves down the plate as shown in Fig. 1.

Figure 1: Natural transition of a laminar-turbulent boundary layer on a smooth flat plate

Initially, this example assumes the flow is laminar on the first part of the plate. Ideally, laminar flow has streamlines that do not interact and the flow moves in roughly parallel planes. However, as the flow moves further along the plate, small vortices begin to form near the surface. As these vortices decay, the flow becomes increasingly turbulent. Turbulent flow exhibits strong mixing of mass, momentum, and energy through vortices and eddies. The process of shifting from laminar flow to turbulent flow is called transition, and it is a complex process which can take multiple forms, one of which is shown looking down on the plate in Fig. 1.

The most common parameter used in determining if flow is laminar or turbulent is the Reynolds number (Re). Reynolds number is a dimensionless quantity representing the ratio of momentum or inertial forces to viscous forces in a boundary layer. It is a function of fluid density, freestream velocity, plate length from the leading edge to the point of interest, and fluid dynamic viscosity. A common approximation for a smooth flat plate is th transition from laminar to turbulent flow takes place when the Reynolds number as a function of the distance along the plate reaches a critical value, typically Re distance to the surface of the plate y to the boundary layer thickness δ. Two approximations have been shown to work well:

$$\frac{u}{U} = \frac{3}{2}\left(\frac{y}{\delta}\right) - \frac{1}{2}\left(\frac{y}{\delta}\right)^3 \quad \text{Nikuradse cubic approximation for Laminar B.L.} \quad (1)$$

$$\frac{u}{U} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}} \quad \text{Power law profile for Turbulent B.L.} \quad (2)$$

EXPERIMENT

1. Record the ambient temperature and pressure in the room.
2. Determine the wind speed the tunnel must run below to ensure laminar flow over the smooth plate. Th means the Reynolds number must be kept below the transitional value for air flow over a flat plate.
3. Knowing the wind speed and the Reynolds number, calculate the respective maximum dynamic pressu Dynamic pressures measured during this lab should not exceed this value. If they do, you need to recheck your calculations or adjust the airspeed of the apparatus. Be aware that the probe is a static Pitot tube where the tip of the tube reads total pressure $P_t = (½ \rho V^2 + P)$. The manometer in Lab View will present dynamic pressure based on comparing the static and total pressures.
4. Put the plate into the test section with the smooth side facing the probe and micrometer. Adjust the micrometer so that the probe just touches the plate surface. To ensure that it is placed correctly, you should be able to slide a piece of paper between the probe and plate while encountering only a slight resistance. Note the distance from the leading edge of the plate to the location of the pitot-static probe as this is the distance x in the Reynolds number calculation.

Figure 2: Pitot-static tube conventions

5. Take at least 5 pressure readings in Lab View for every 0.2 mm movement of the probe until the probe out of the boundary layer. (How does one know when the probe is out of the boundary layer?) Once you have all your data, remove the highest and lowest values from each point and average the values are left. That will be the value for that point. (How many points might be appropriate to take given small sample errors?)
6. Perform Step 4 and Step 5 with the rough side of the plate facing the probe to attempt to induce larger Reynolds numbers. You can also slide the plate further toward the wind inlet to assist in this endeavo

DATA ANALYSIS

1. Plot two figures.
   a. Experimental smooth side distribution AND both the laminar and turbulent velocity distribution approximations from Eq. (1) and (2).
   b. Experimental rough side distribution and its approximations from Eq. (1) and (2).

   Remember that the x-axis and y-axis are normalized so their maximum values should be about one.

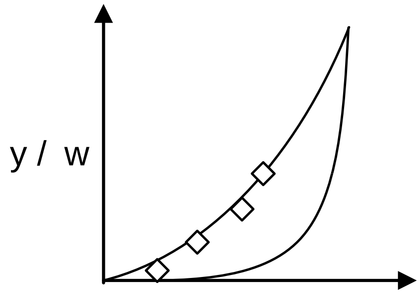


Figure 3: Example velocity profile graph

2. Compute the difference at each y/ SRLQW EHWZHHQ WKH H[SHULPHQWDO Q
   laminar and turbulent approximations in equations 3 and 4. Place these differences in a table in your report. These differences can be multiplied by 100 to obtain the local percent error (you do not need to divide the difference in this case since all of the values are normalized already). These local percent errors should be aggregated together and averaged to obtain a mean percent error for that compariso This should be done for four cases: smooth (experiment) vs. laminar (theory), smooth (experiment) vs. turbulent (theory), rough (experiment) vs. laminar (theory), rough (experiment) vs. turbulent (theory). Discuss these percent errors as indications of whether or not laminar or turbulent flow was observed i each side of the plate (it might not be smooth = laminar, rough = turbulent; if neither, what would it be? Refer to Fig. 1 to help answer this). Also discuss possible sources of error in these results and their possible effects.
3. Compute the small sample (t-distribution) error range on three selected points (one near the bottom, o in middle, one near the top of the boundary layer) for the rough and smooth plate data sets assuming 90%/95% confidence. What, if any, are the implications of this measurement error on the discussion o Step 2?
4. 2EWDLQ WKH SHUFHQW HUURU EHWZHHQ x (non-dimensional boundary layer WKH H[SHULPHQWD
   thickness where x is the length term used in Reynolds number equation) and the empirical equations below. In total there should be four cases with percent error (same as step 2). Discuss what these resu imply about the boundary layer structure (for example laminar v. turbulent) and uncertainties associate with this analysis approach.

	G/ x
Laminar Cubic Approximation	$4.6/(Re_x)^{1/2}$
Turbulent Power Law Approximation	$0.37/(Re_x)^{1/5}$

APPENDIX

Useful Equations

Density: $\rho = \dfrac{P_{room}}{RT_{room}}$ (R = 287.2 $\dfrac{Nm}{kgK}$ and T in K)

Coefficient of absolute viscosity: $\mu = 1.458 \times 10^{-6} \dfrac{T^{1.5}}{T + 110.4} \quad \dfrac{kg}{s \cdot m}$

Reynolds's Number: $Re_x = \dfrac{V \cdot x}{\nu}$ Kinematic viscosity: $\nu = \dfrac{\mu}{\rho}$

Distance from plate: y = micrometer reading − micrometer reading at plate + t/2

Boundary Layer thickness: δ Determine by observation of data (u/U = 1)

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 4014 (Senior Design 2), spring 2023

Location in Program: Early Middle End

Learning Outcome 3: An ability to communicate effectively with a range of audiences.

Method: Powerpoint presentations, written final reports, class participation

Rubric: A score of 3.0 and above on a scale of 5.0 (5-Outstanding, 4-Excellent, 3-Good, 2-Satisfactory, 1-Poor)
1. Below Expectations: Fails to address considerations named in the [illegible]

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Program (AE or ME): ME   Date materials reviewed: 11/11/2023

Criterion reviewed (circle one): 1 2 3 4 5 6 7

an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

Semester(s) reviewed: Fall 2022, Spring 2023 (primarily)

Reviewers: Alexander, Babaiasl, Condoor, Gurajan, Jayaram, LeBeau, Ma, Marmolejo, Swartwout

Coursesc 9Wiew3r, Gur

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 4004 (Senior Design 1), fall 2022

Location in Program Early Middle End

An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Method: Homeworks 1 2 and 3. Supportive documentation in Final Reports.

Rubric A score of 3.0 and above on a scale of 5.0 (5-Outstanding, 4-Excellent, 3-Good, 2-Satisfactory, 1-Poor)
1. Below Expectations: Fails to address considerations named in the learning outcome
3. Meets Expectations: Student addresses considerations named in the learning outcome
5. Exceeds expectations: Student works with team to modify own initial thoughts and approaches to address self improvement and develop leadership skills, as well as create a collaborative and inclusive environment,

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Introduction to Homework 1:

MENG 4004 Engineering Design 1

Homework 3, due 11:59 pm on Tue Nov 8 2022, Canvas Submission per team

This is in collaboration with your teammates, but not your classmates outside the team. One submission per team. Please answer each of 3 questions with specific and concrete items, succinctly,

AEME ABET Assessment Review Form

Points Possibl	90	
ME1		
ME2		
ME3	86	Meets Expectations
ME4	90	Meets Expectations
ME5	86.5	Meets Expectations
ME6	88	Meets Expectations
ME7		

Criteria	Ratings					Pts
First Research Question The research question is a) relevant to your part of the project, b) involves a question to be answered or something to be learned, and c) is narrow enough that it can be resolved with a search.	6 pts Full Marks	5 pts Some answers are incomplete or missing	4 pts Mostly there	2 pts Lots of missing items	0 pts Didn't do this	6 pts
Second Research Question The research question is a) relevant to your part of the project, b) involves a question to be answered or something to be learned, and c) is narrow enough that it can be resolved with a search.	6 pts Full Marks	5 pts Some answers are incomplete or missing	4 pts Mostly there	2 pts Lots of missing items	0 pts Didn't do this	6 pts
Third Research Question The research question is a) relevant to your part of the project, b) involves a question to be answered or something to be learned, and c) is narrow enough that it can be resolved with a search.	6 pts Full Marks	5 pts Some answers are incomplete or missing	4 pts Mostly there	2 pts Lots of missing items	0 pts Didn't do this	6 pts
Reference 1-1 [Note: the first number is the question, the second is the reference] The reference is from a Libraries search, and addresses the research question (Repeat for references 1-2, 1-3, 2-1, 2-2, 2-3, 3-1, 3-2, 3-3)	4 pts Full Marks	3 pts Library search but relevance is iffy	2 pts Not from a library search	1 pts Not from the library, doesn't seem to address the question	0 pts Didn't do this	4 pts

Explanation for Reference 1-1

[Note: the first number is the question, the second is the reference]

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 2000 Foundation to Engineering Design (F2022)

Location in Program Early Middle End

Learning Outcome 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Instrument: Design Project

Learning Outcome: 1 (Solve Problems using SEM) 2 (Design in Global Context) 3 (Effective Communication)
[select 1] 4 (Ethics in Global Context) 5 (Functional Teamwork) 6 (Experiment and Draw Conclusions)
7 (Lifelong Learning)

Course: MENG 2000 Foundation to Engineering Design (F2022)

Location in Program: Early **Middle** End

Learning Outcome 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Instrument: Bridge-building competition (instructions included).

Methodology: Students are instructed to build a bridge using popsicle sticks and glue. Students are expected to perform research on bridge design and identify the main opportunities for optimization their design. Projects are graded on the ingenuity of the design, the ‘budget’ for building it, and the bridge’s load-carrying ability.

Rubric: See instructions attached.

Desired result: 70% of students scoring Meets or Above Expectations

Students assessed: The class consisted of 5 mechanical engineering students.

Student performance: 2 students had ‘Above Expectations’ and 3 students had ‘Met Expectations’.

Observations: Students properly identified the problem or need for which they were designing a solution. The bridge designs were functional and demonstrated good understanding of the design principles.

Assessment: 100% of the mechanical engineering students met or exceeded expectations.

Proposed Action: No action is needed.

MENG 2000

Foundations to Engineering Design

Project 1

Bridge Building Contest

Synopsis

During the last electoral cycle for a new mayor in the great town of Elmirsville, Dr. Charles El Mir emerged as the clear winner. Unfortunately, he is long overdue on his electoral promise to “Build that Bridge”, and his poll numbers have bee quickly plummeting. With his eyes set out for re-election, he sent a ‘request for proposal’ (RFP) to local engineering firms that are specialized in building bridges.

The mayor outlined his request as follows:

- The bridge needs to be aesthetically appealing.
- Cars need to be able cat18.8 (i)-3.2 (s)-4.3 (e)-6 (l)7.6 .8 (rBbe)-6 (s)y <</M bhppg.

The bridge should not weigh more than 550g and, ideally, should not be made with more than 300 popsicle sticks.

Materials

The market price for the materials required for building the bridge are:

Material	Qty	Unit	Price (USD)	
Popsicle Sticks	1	each	Pre-bid	1000
			Post-bid	2000
Glue	50	g	Pre-bid	5000
			Post-bid	6000

Table 1.1: Pricing of the materials used in the bridge construction

There will be an initial supply of materials, during the pre-bid stage, at a reduced cost. Any additional materials requested after the initial stage will include a surplus.

Scoring

The prototypes will be ranked according to aesthetical appearance, best estimated load capacity, actual load capacity, efficiency rae,adacity, The first round of bidding will take place on February 28, 2022. Companies must submit their first proposal, which must include a schematic of the bridge to be constructed, the total budget requested, and an itemized breakdown of the materials.

The company with the lowest budget will be awarded with additional bonus point(a)-3.2 (l)-3u099]/Subt (a)-3D 85(e)-T

- Realize that the score is heavily influenced by the initial weight of the bridge. Try to maximize the strength of the