

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING
CVEG 2101- Materials & Dynamics Laboratory
FALL 2021**

I. COURSE DESCRIPTION IN ABET FORMAT

**II. ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS –
NONE – EFFECTIVE FALL 2021**

Program Outcomes Assessed in Course – None – Effective Fall 2021

**Assessment Summary of Class Semester Averages for Outcomes – None -
Effective Fall 2021**

**End of Semester Course Outcomes Assessment Reports – None – Effective
Fall 2021**

III. TESTS

Summary of Topics covered by Test

Original Test Questions & Master Solution/grading scheme used

(Summary of topics can be a separate page or include on the assignment itself)

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

IV. HOMEWORK ASSIGNMENTS

Summary of Topics covered by Assignments

Original Assignment Questions & Master Solution/grading scheme used

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

V. LABORATORY ASSIGNMENTS

Summary of Topics covered by Term Project

Original Term Project Format & Master Solution/grading scheme used

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

Course Description in ABET Format

1.	Course number and name:	CVEG 2101 MATERIALS AND DYNAMICS LAB
2.	Credits and contact hours:	1 credit hour; 3 contact hours
3.	Instructor's or course coordinator's name:	Dr. Judy A. Perkins, PE; Dr. Md Jobair Bin Alam, PE; and Dr. Ramalingam Radhakrishnan, PE
4.	Text book: Title:	1. Mechanics of Materials (10th Edition) 2. Statics and Dynamics (14th Edition)
	Author(s):	1. R.C. Hibbeler 2. R.C. Hibbeler
	Publisher, Year & Edition:	1. Pearson, 2018, 10 th Edition 2. Pearson, 2016, 14 th Edition
	a. Other Supplemental Material	Class handouts and representative problems from various sources
5.	Specific course information	
	a. Brief description of the content of the course (catalog description)	CVEG 2101. Materials and Dynamics lab. 1 Credit. Determination of mechanical properties of engineering materials, Stress-Strain relationship of materials, tensile testing of steel, torsion, bending and shear of materials, conservation principles, kinematics and kinetics, momentum, work and energy principles, Dynamic loads.
	b. Prerequisites or Co-requisites	ENGL 1302 (previous course number ENGL 1133) or ENGL 2311 (previous course number ENGL 1143) and CVEG 2301 (previous course number was CVEG 2043)
	c. *Indicate whether a required, elective, or selected elective (as per definition provided) course in the program	Required
6.	a. Specific goals for the course specific outcomes of instruction (e.g., The student will be able to explain the significance of current research about a particular topic.) <i>Students will be able to :</i>	b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. <i>The specific goals for the course specific outcomes listed on the left column will address the following student learning outcomes:</i>
	1. To develop the ability to analyze engineering mechanics problems using the principles of science and mathematics;	There are no ABET Student Outcomes assigned for this course.
	2. To develop the ability to describe and analyze the conditions of moment and shear of equilibrium of particles, rigid bodies, and structures; and	There are no ABET Student Outcomes assigned for this course.
	3. To develop the ability to analyze the dynamic behavior, kinetics and kinematics of particles, and analyze dynamic load.	There are no ABET Student Outcomes assigned for this course.
7	Brief List of Topics to Be Covered	• Course Introduction/Course Maintenance/ Laboratory Safety Training (3 hours) • Introduction to Engineering Properties of Materials (3 hours) • Stress-Strain Test and Determination of Engineering Properties of Materials (3 hours) • Review of Axial Load and Beam Bending (3 hours) • Determination of Torsional Properties of

	Engineering Material (3 hours)
	• Determination of Spring Constant (3 hours)
	• Review of Kinematics (3 hours)
	• Review of Kinetics (3 hours)
	• Pulley-Cable System (3 hours)
	• Simple Pendulum Test to Determine Gravitational Acceleration (3 hours)
	• Review of Rigid Body Kinematics (3 hours)

Additional Course Syllabus Information

Section # and CRN: Section P81 and CRN - 17611

Office Location: 110E in C.L. Wilson Building

Office Phone: 936.261.1655

Email Address: juperkins@pvamu.edu

Office Hours: 8:30 am to 10:00 am Friday or by Appointment

Mode of Instruction: Face-to-Face (and Zoom as announced)

Course Location: Room 109-F in C.L. Wilson Building

Class Days & Times: 10am – 12:50pm on Friday

Major Course Requirements

Method of Determining Final Course Grade

Course Grade Requirement	Value (points or percentages)	Total
1. Attendance and Quiz	10	100
2. Tests/Exams	40	400
3. Homework Assignments	10	100
4. Lab Assignments	10	100
5. Final Exam	30	300
Total:	100	1000

Grading Criteria and Conversion:

A = 90 - 100%

B = 80 - 89%

C = 70 – 79%

D = 60 – 69%

F = 0 - 59%

Detailed Description of Major Assignments:

Assignment Title or Grade Requirement	Description
1. Quizzes	Periodic pop quizzes to measure knowledge of presented course material
2. Tests/Exams	Written tests designed to measure knowledge of presented course material
3. Homework Assignments	Periodic written assignments designed to supplement and reinforce course material
4. Lab Assignments	Periodic lab assignments designed to engage students in collaborative, team-based learning to supplement and reinforce course material
5. Final Exam	Comprehensive closed book examination.

Additional Notes:

- Attendance in the class is **mandatory** and students are expected to report to class on time. **Attendance will be taken at the beginning of class and may be taken at the end of class.** Read the attached University Class Attendance Policy.
- Turn cell phones and other electronic devices off or place them in the silence mode prior to the start of class. They must remain off or in the silence mode while class is in session. If you are expecting an emergency call, exit the classroom to take the call. *For online (Zoom) class sessions ALWAYS place your microphone on MUTE during the class unless otherwise instructed.*
- No makeup exams(s) will be given. For missed exam(s) you will receive **zero** grade. Excused absences will

require documentation. A written excuse is required via email to the Instructor. Failure to sit for and complete the Final Exam will result in an automatic "F" grade for the course.

- Late homework will not be accepted. Please refer to Homework submission requirements.
- For grading/class related appeals (see the PVAMU Undergraduate Catalog)
- Cheating on an exam or homework and other forms of academic dishonesty could result in a grade of "F" for the course AND administrative referral with the maximum penalty recommended. Please refer to the CEE Policy to Eradicate Cheating.
- To contact the Instructor via email, please use as the Subject: "Course Number and Section," include your Full Name in the body of the email, start with the main issue/question of the communication.

TaskStream

TaskStream is a tool that Prairie View A&M University uses for assessment purposes. One of your assignments may be required to be submitted as an "artifact," an item of coursework that serves as evidence that course objectives are met. If applicable, more information will be provided during the semester by your department, but for general information, you can visit **TaskStream** via the link in eCourses.

This course does not have a Taskstream Assignment.

Course Procedures

Submission of Assignments:

Homework Assignment Submission

Dates to submit assignments will be provided to you at the time the assignment is handed out. **LATE ASSIGNMENTS WILL NOT BE ACCEPTED!!** Use the following format for all of your homework:

1. Your homework should be complete, neat, and professionally presented.
2. Use **only engineering paper (no graph paper)** for submitting your homework
3. Your homework should have the following on top of the first sheet
 - a. Your name and Roster Number
 - b. Course prefix, number, section, and title
 - c. Homework number
 - d. Date Given
 - e. Date Due
4. Five (5) points will be deducted for improper cover pages.
5. Drawing of free body diagram is must for the questions which need Free body Diagram.
6. Show all steps for arriving to the final answer clearly. Include all appropriate sketches.
7. Reference all figures, tables, constant values, equations, and conversions used to complete the problem.
8. Include all the appropriate units throughout the solution. Points will be deducted for answers presented without the appropriate units.
9. **Start a new page for every new problem.**
10. Problems should be in the order assigned.

Laboratory Assignments Submission (unless told otherwise)

Dates to submit laboratory assignments will be provided to you at the time the assignment is handed out. **LATE ASSIGNMENTS WILL NOT BE ACCEPTED!!** Use the following format for all of your lab reports:

1. Your lab report should have the following on the cover page
 - a. Your name or Group name/number and its members
 - b. Course prefix, number, section, and title
 - c. Laboratory Title
 - d. Date Given
 - e. Date Due
2. Five (5) points will be deducted for improper cover pages.
3. Table of Contents, Abstract, Introduction, Theory, Test Procedures, Detail Results, Discussion of Test Results, Appendices, References, etc. should be included in the report
4. Show all steps for arriving to the final answer clearly. Include all appropriate sketches.
5. Reference all figures, tables, constant values, equations, and conversions used to complete the problem.
6. Include all the appropriate units throughout the solution. Points will be deducted for answers presented without the appropriate units.

7. Minor guidance may vary from one lab report to another

Exam Policy:

Exams should be taken as scheduled. No makeup examinations will be allowed except under documented emergencies (See Student Handbook).

CEE POLICY TO ERADICATE CHEATING (PROTECT INTEGRITY OF EXAMS)

Cheating is unprofessional, unethical and is antithetical to our core value of "Excellence in Civil Engineering Education," and WILL NOT BE TOLERATED at any level. To combat this serious problem, the Civil & Environmental Engineering (CEE) Department has adopted the following rules to eradicate cheating.

- If a student cheats on a test/assignment, the student shall receive an automatic zero for the test/assignment.
- A student who has been determined to have cheated in a course will IMMEDIATELY relinquish his/her leadership position in any of the department's professional organizations.
- If a student cheats multiple times in a course, the student will receive a grade of "F" for the course.
- The calculators allowed for use in exams may be restricted to the latest FE-approved calculators. For the latest NCEES FE approved calculators visit ncees.org or <https://ncees.org/exams/calculator/>
- [This NCEES policy protects the integrity of NCEES exams and has been adopted to do likewise for department's exams.]

Exam Guidelines

- All cellphones/smartwatches MUST be placed in a book bags during exams and turned off. Book bags MUST be placed in front of the classroom and away from students. Students without a book bag must place cellphone/smartwatch (turned off) on Instructor's desk – no exceptions
- Any student possessing a cellphone/smartwatch or any other unauthorized device WILL receive an automatic zero for the test/assignment. This is cheating.
- Calculator covers are DISALLOWED during tests and must be placed in students' book bags during exams.
- There shall be NO SHARING of resources during the exam
- Restroom Visit: if you need to use the restroom, do so before opening the exam. Once the exam begins, you must submit your work to the instructor if you leave the classroom to visit the rest room (your exam terminates).

The following policy is only for students who have declared a major (Engineering, Computer Science, and/or Technology) in the Roy G. Perry College of Engineering.

College of Engineering (CoE) Textbook Policy:

Students MUST acquire the required textbook that is listed on the course syllabus for this course. The textbook must be acquired by the 10th class day. Students are not allowed to share textbooks with students who are currently registered in the same class. Failure to acquire (or show proof of purchase) the required textbook by the 10th class day will result in the student being administratively dropped from the course. The University will assess financial obligations for the course to the student as with any other dropped class according to the fee schedule as well as your financial aid may be affected.

If you are not financially able to purchase a required textbook for an engineering course prior to the 10th class day, you may apply to the College of Engineering Textbook Fund for a textbook voucher. The voucher can only be used at the Campus Bookstore. Additional information about the College of Engineering Textbook Policy and the CoE Textbook Fund may be found at <http://www.pvamu.edu/engineering/>. The student may need to contact the Director of Engineering Student Services) in the CoE Dean's office (350 SR Collins).

Important Semester Dates

- Week 3 – Labor Day Holiday on Monday, September 6, 2021
- Week 3 – Last Day to Withdraw from Course(s) without academic record, Tuesday, Sept. 7, 2021
- Week 3 – Withdrawal from course(s) with academic record ("W") Begins on Wednesday, Sept. 8, 2021
- Week 8 – Mid-Semester Examination Period, Thursday – Saturday, October 14-16, 2021
- Week 9 – Mid-Semester Grades Due on Wednesday, October 20, 2021
- Week 11 – Withdrawal from course(s) with academic record ("W") Ends on Monday, Nov. 1, 2021
- Week 12 - Priority Registration Period for Spring 2022 Begins on Nov. 8, 2021
- Week 14 – Thanksgiving Break, Thursday - Saturday, Nov. 25-27, 2021
- Week 15 – Last Class Day for Fall Semester, Wednesday, Dec. 1, 2021

16 WEEK CALENDAR

Week 1: Topic(s)	Course Introduction, Course Maintenance, Introduction to Stress & Strain
Chapter(s):	Chapters 1-2 in Textbook #1
Assignment(s):	None
Week 2: Topic	Mechanical Properties of Materials
Chapter(s):	Chapter 3 in Textbook #1
Assignment(s):	Homework # 1: Select Problems are Assigned
Week 3: Topic(s)	Spring Constant
Chapter(s):	Handouts
Assignment(s):	Lab Report #1 – Spring
Week 4: Topic(s)	Axial Loads and Shear
Chapter(s):	Chapters 4 and 7 in Textbook #1
Assignment(s):	Lab Report # 2 – Axial Loads and Shear
Week 5: Topic(s)	Torsion
Chapter(s):	Chapter 5 in Textbook #1
Assignment(s):	Homework #2: Select Problems are Assigned
Week 6: Topic(s)	Bending and Deflection
Chapter(s):	Chapters 6 and 12 in Textbook #1
Assignment(s):	Lab Report # 3 – Torsion Test and Lab #4 - Bending and Deflection Test
Week 7: Topic(s)	None
Chapter(s):	None
Assignment(s):	Mid-Term Exam
Week 8: Topic(s)	Review of Kinematics
Chapter(s):	Chapter 12 in Textbook #2
Assignment(s):	None
Week 9: Topic(s)	Review of Kinetics
Chapter(s):	Chapters 13 – 15 in Textbook #2
Assignment(s):	Homework #3 – Select Problems are Assigned
Week 10: Topic(s)	Lab Report #5 - Pulley Cable System
Chapter(s):	Handouts
Assignment(s):	None
Week 11: Topic(s)	Simple Pendulum
Chapter(s):	Handouts
Assignment(s):	Lab Report # 6 – Simple Pendulum
Week 12: Topic(s)	Review of Rigid Bodies Kinematics
Chapter(s):	Chapter 16 in Textbook #2
Assignment(s):	Exam #2 and Lab Report #7: Rotating Disks (Rigid Bodies)
Week 13: Topic(s)	Dynamic Loads (Vibration)
Chapter(s):	Chapter 22 and Handouts
Assignment(s):	Course Evaluation and Course Review for Final Examination
Week 14: Topic(s)	None
Chapter(s):	None
Assignment(s):	Thanksgiving Holiday (November 25-27, 2021)
Week 15: Topic	Last Class Day is December 1, 2021
Chapter(s):	None
Assignment(s):	None
Week 16: Topic(s)	None
Assignment(s):	Comprehensive Final Exam Period – December 2-8, 2021

Student Support and Success

John B. Coleman Library

The John B. Coleman Library's mission is to enhance the scholarly pursuit of knowledge, to foster intellectual curiosity, and to promote life-long learning and research through our innovative services, resources, and cultural programs, which support the Prairie View A&M University's global mission of teaching, service, and research. It maintains library collections and access both on campus, online, and through local agreements to further the educational goals of students and faculty. Website: <https://www.pvamu.edu/library/>; Phone: 936-261-1500

Academic Advising Services

Academic Advising Services offers students a variety of services that contributes to student success and leads towards graduation. We assist students with understanding university policies and procedures that affect academic progress. We support the early alert program to help students get connected to success early in the semester. We help refer students to the appropriate academic support services when they are unsure of the best resource for their needs. Faculty advisors support some students in their respective colleges. Your faculty advisor can be identified in PantherTracks. Advisors with Academic Advising Services are available to all students. We are located across campus. Find your advisor's location by academic major at www.pvamu.edu/advising. Phone: 936-261-5911

The University Tutoring Center

The University Tutoring Center (UTC) offers free tutoring and academic support to all registered PVAMU students. The mission of the UTC is to help provide a solid academic foundation that enables students to become confident, capable, independent learners. Competent and caring staff and peer tutors guide students in identifying, acquiring, and enhancing the knowledge, skills, and attitudes needed to reach their desired goals. Tutoring and academic support are offered face-to-face in the UTC, in virtual face-to-face sessions (<https://www.pvamu.edu/student-success/sass/university-tutoring-center/>), and through online sessions (<https://www.pvamu.edu/pvplace/>). Other support services available for students include Supplemental Instruction, Study Break, Academic Success Workshops, and Algebra Study Jam. Location: J. B. Coleman Library, Rm. 307; Phone: 936-261-1561; Email: pvtutoring@pvamu.edu; Website: <https://www.pvamu.edu/student-success/sass/university-tutoring-center/>

Writing Center

The Writing Center provides well-trained peer tutors to assist students with writing assignments at any stage of the writing process. Tutors help students with various writing tasks from understanding assignments, brainstorming, drafting, revising, editing, researching, and integrating sources. Students have free access to Grammarly online writing assistance. Grammarly is an automated proofreading and plagiarism detection tool. Students must register for Grammarly by using their student email address. In addition, students have access to face-to-face and virtual tutoring services either asynchronously via email or synchronously via Zoom. Location: J. B. Coleman Library, Rm. 209; Phone: 936-261-3724; Website: <https://www.pvamu.edu/student-success/writing-center/>; Grammarly Registration: <https://www.grammarly.com/enterprise/signup>

Academic Early Alert

Academic Early Alert is a proactive system of communication and collaboration between faculty, academic advisors, and PVAMU students that is designed to support student success by promptly identifying issues and allowing for intervention. Academic Early Alerts help students by providing a central location to schedule advising appointments, view advisor contact information, and request assistance. Students who recognize that they have a problem that is negatively affecting their academic performance or ability to continue school may self-refer an Academic Early Alert. To do so, students will log in to PV Place and click on Academic Early Alert on the left sidebar. Phone: 936-261-5902; Website: <https://www.pvamu.edu/student-success/early-alert/>

Student Counseling Services

The Student Counseling Services unit offers a range of services and programs to assist students in maximizing their potential for success: short-term individual, couples, and group counseling, as well as crisis intervention, outreach, consultation, and referral services. The staff is licensed by the State of Texas and assists students who are dealing with academic skills concerns, situational crises, adjustment problems, and emotional difficulties. Information shared with the staff is treated confidentially and in accordance with Texas State Law. Location: Hobart Taylor, 2nd floor; Phone: 936-261-3564; Website: <https://www.pvamu.edu/healthservices/student-counseling-services/>

Office of Testing Services

Testing Services serves to create opportunities by offering a suite of exams that aid in the students' academic and professional success. Currently, we administer entrance (HESI A2), college readiness (TSI assessment), Prior Learning (CLEP, DSST), and proctored exams. Location: Wilhelmina Delco, 3rd Floor, Rm. 305; Phone: 936-261-3627; Email: aetesting@pvamu.edu; Website: www.pvamu.edu/testing

Office of Diagnostic Testing and Disability Services

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, contact the Office of Disability

Services. As a federally-mandated educational support unit, the Office of Disability Services serves as the repository for confidential disability files for faculty, staff, and students. For persons with a disability, the Office develops individualized ADA letters of request for accommodations. Other services include learning style inventories, awareness workshops, accessibility pathways, webinars, computer laboratory with adapted hard and software, adapted furniture, proctoring non-standardized test administrations, ASL interpreters, ALDs, digital recorders, Livescribe, and a comprehensive referral network across campus and the broader community. Location: Hobart Taylor, Rm. 1D128; Phone: 936-261-3583; Website: <https://www.pvamu.edu/disabilityservices/>

Center for Instructional Innovation and Technology Services (CIITS)

Distance Learning, also referred to as Distance Education, is the employment of alternative instructional delivery methods to extend programs and services to persons unable to attend college in the traditional manner. The Center for Instructional Innovation and Technology Services (CIITS) supports student learning through online, hybrid, web-assist, and 2-way video course delivery. For more details and contact information, visit: <https://www.pvamu.edu/dlearning/distance-learning-2-2/students-2/>; Phone: 936-261-3283

Veteran Affairs

Veterans Services works with student veterans, current military and military dependents to support their transition to the college environment and continued persistence to graduation. The Office coordinates and certifies benefits for both the G.I. Bill and the Texas Hazlewood Act. Location: Evans Hall, Rm. 102; Phone: 936-261-3563; Website: <https://www.pvamu.edu/sa/departments/veteranaffairs/>

Office for Student Engagement

The Office for Student Engagement delivers comprehensive programs and services designed to meet the co-curricular needs of students. The Office implements inclusive and accessible programs and services that enhance student development through exposure to and participation in diverse and relevant social, cultural, intellectual, recreational, community service, leadership development, and campus governance. Location: Memorial Student Center, Rm. 221; Phone: 936-261-1340; Website: <https://www.pvamu.edu/studentengagement/>

Career Services

Career Services supports students through professional development, career readiness, and placement and employment assistance. The Office provides one-on-one career coaching, interview preparation, resume and letter writing, and career exploration workshops and seminars. Services are provided for students at the Northwest Houston Center and College of Nursing in the Medical Center twice a month or on a requested basis. Distance Learning students are encouraged to visit the Career Services website for information regarding services provided. Location: Anderson Hall, 2nd floor; Phone: 936-261-3570; Website: <https://www.pvamu.edu/careerservices/>

University Rules and Procedures

Academic Misconduct

Academic dishonesty is defined as any form of cheating or dishonesty that has the effect or intent of interfering with any academic exercise or fair evaluation of a student's performance. The college faculty can provide additional information, particularly related to a specific course, laboratory, or assignment.

You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with the *University Administrative Guidelines on Academic Integrity*, which can be found on the [Academic Integrity webpage](#). Students who engage in academic misconduct are subject to university disciplinary procedures. As listed in the *University Administrative Guidelines on Academic Integrity*, the University Online Catalog, and the Student Code of Conduct, the following are examples of prohibited conduct. This list is not designed to be all-inclusive or exhaustive. In addition to academic sanctions, any student found to have committed academic misconduct that is also a violation of criminal law may also be subject to disciplinary review and action by the Office of Student Conduct (as outlined in the Student Code of Conduct).

Forms of Academic Dishonesty:

1. Cheating: Deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not learned, giving or receiving aid unauthorized by the instructor on assignments or examinations. Examples: unauthorized use of notes for a test; using a "cheat sheet" on a quiz or exam; any alteration made on a graded test or exam which is then resubmitted to the teacher;

2. **Plagiarism:** Careless or deliberate use of the work or the ideas of another; representation of another's work, words, ideas, or data as your own without permission or appropriate acknowledgment. Examples: copying another's paper or answers, failure to identify information or essays from the internet and submitting or representing it as your own; submitting an assignment which has been partially or wholly done by another and claiming it as yours; not properly acknowledging a source which has been summarized or paraphrased in your work; failure to acknowledge the use of another's words with quotation marks;
3. **Collusion:** When more than one student or person contributes to a piece of work that is submitted as the work of an individual;
4. **Conspiracy:** Agreeing with one or more persons to commit an act of academic/scholastic dishonesty; and
5. **Multiple Submission:** Submission of work from one course to satisfy a requirement in another course without explicit permission. Example: using a paper prepared and graded for credit in one course to fulfill a requirement and receive credit in a different course.

Nonacademic Misconduct

The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor's ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. The Office of Student Conduct will adjudicate such incidents under nonacademic procedures.

Sexual Misconduct

Sexual harassment of students and employees at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating the university's sexual harassment policy will be subject to disciplinary action. In accordance with the Texas A&M University System guidelines, your instructor is obligated to report to the Office of Title IX Compliance (titleixteam@pvamu.edu) any instance of sexual misconduct involving a student, which includes sexual assault, stalking, dating violence, domestic violence, and sexual harassment, about which the instructor becomes aware during this course through writing, discussion, or personal disclosure. The faculty and staff of PVAMU actively strive to provide a learning, working, and living environment that promotes respect that is free from sexual misconduct, discrimination, and all forms of violence. If students, faculty, or staff would like assistance or have questions, they may contact the Title IX Coordinator at 936-261-2144 or titleixteam@pvamu.edu. More information can be found at www.pvamu.edu/titleix, including confidential resources available on campus.

Pregnancy, Pregnancy-related, and Parenting Accommodations

Title IX of the Education Amendments of 1972 prohibits sex discrimination, which includes discrimination based on pregnancy, marital status, or parental status. Students seeking accommodations related to pregnancy, pregnancy-related conditions, or parenting (reasonably immediate postpartum period) are encouraged to contact Student Disability Services or the Dean of Students' Office for additional information and to request accommodations.

Non-Discrimination Statement

Prairie View A&M University does not discriminate on the basis of race, color, sex, religion, national origin, age, disability, genetic information, veteran status, sexual orientation, or gender identity in its programs and activities. The University is committed to supporting students and complying with The Texas A&M University System non-discrimination policy. It seeks to establish an environment that is free of bias, discrimination, and harassment. If you experience an incident of discrimination or harassment, we encourage you to report it. If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are individuals who can meet with you. The Director of Equal Opportunity & Diversity has been designated to handle inquiries regarding the non-discrimination policies and can be reached at Harrington Science Building, Suite 109 or by phone at 936-261-1744 or 1792.

Class Attendance Policy (See the University Online Catalog for Full Attendance Policy)

Prairie View A&M University requires regular class attendance. Attending all classes supports the full academic development of each learner, whether classes are taught with the instructor physically present or via distance learning technologies such as interactive video and/or the internet. Excessive absenteeism, whether excused or unexcused, may result in a student's course grade being reduced or in the assignment of a grade of "F." Absences are accumulated beginning with the first day of class during regular semesters and summer terms. Each faculty member will include the University's attendance policy in each course syllabus.

Student Academic Appeals Process

Authority and responsibility for assigning grades to students rest with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the University Online Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.

Technical Considerations

Minimum Recommended Hardware and Software:

- Intel PC or Laptop with Windows 10 or later version; Mac with OS High Sierra*
- Smartphone or iPad/Tablet with Wi-Fi*
- High-speed Internet access
- 8 GB Memory
- Hard drive with 320 GB storage space
- 15" monitor, 800x600, color or 16 bit
- Sound card w/speakers
- Microphone and recording software
- Keyboard & mouse
- Most current version of Google Chrome, Safari, or Firefox

Note: Be sure to enable Java & pop-ups in the Web browser preferences

*Smartphones, Google Chrome books, and Android tablets may not be supported. iPads are the only tablets supported.

Participants should have a basic proficiency of the following computer skills:

- Sending and receiving email
- A working knowledge of the Internet
- Microsoft Word (or a program convertible to Word)
- Acrobat PDF Reader
- Windows or Mac OS
- Video conferencing software

Netiquette (online etiquette)

Students are expected to participate in all discussions and virtual classroom chats as directed. Students are to be respectful and courteous to others on discussion boards. Foul or abusive language will not be tolerated. Do not use ALL CAPS for communicating to others AS IT CAN BE INTERPRETED AS YELLING. Avoid slang terms such as "wassup?" and texting abbreviations such as "u" instead of "you." Limit and possibly avoid the use of emoticons. Be cautious when using humor or sarcasm as tone is sometimes lost in an email or discussion post, and the message might be taken seriously or sound offensive.

Video Conferencing Etiquette

When using Zoom, WebEx, or other video conferencing tools, confirm the visible area is tidy, clear of background clutter, inappropriate or offensive posters, and other distractions. Ensure you dress appropriately and avoid using high traffic or noisy areas. Stay muted when you are not speaking and avoid eating/drinking during the session. Before the class session begins, test audio, video, and lighting to alleviate technology issues.

Technical Support

Students should go to <https://mypassword.pvamu.edu/> if they have password issues. The page will provide instructions for resetting passwords and contact information if login issues persist. For other technical questions regarding eCourses, call the Center for Instructional Innovation and Technology Services at 936-261-3283 or email ciits@pvamu.edu.

Communication Expectations and Standards

Emails or discussion postings will receive a response from the instructor, usually in less than 48 hours. Urgent emails should be marked as such. Check regularly for responses.

Discussion Requirement

Online courses often require minimal to no face-to-face meetings. However, conversations about the readings, lectures, materials, and other aspects of the course can occur in a seminar fashion. The use of the discussion board will accomplish this. The instructor will determine the exact use of discussion boards.

It is strongly suggested that students type their discussion postings in a word processing application such as Word and save it to their PC or a removable drive before posting to the discussion board. This is important for two reasons: 1) If for some reason your discussion responses are lost in your online course, you will have another copy; 2) Grammatical errors can be greatly minimized by the use of the spell-and-grammar check functions in word processing applications. Once the post(s) have been typed and corrected in the word processing application, copy and paste to the discussion board.

COVID-19 Campus Safety Measures

To promote public safety and protect students, faculty, and staff during the coronavirus pandemic, PVAMU has adopted policies and practices to limit virus transmission.

- **Self-monitoring** - Students should follow CDC recommendations for self-monitoring. Students who have a fever or exhibit symptoms of COVID-19 should participate in class remotely and should not participate in face-to-face instruction.
- **Face Coverings** - Face coverings (cloth face covering, surgical mask, etc.) are recommended in classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource, and support offices, and outdoor spaces where 6 feet of physical distancing is challenging to maintain reliably.
- **Physical Distancing** - Physical distancing should be maintained between students, instructors, and others in course and course-related activities where possible.
- **Personal Illness and Quarantine** - Students required to quarantine are to participate in courses and course-related activities remotely and must not attend face-to-face course activities. Students should notify their instructors of the quarantine requirement. Students under quarantine are expected to participate in courses and complete graded work unless they have symptoms that are too severe to participate in course activities. Students experiencing personal injury or illness that is too severe for the student to attend class qualify for an excused absence. To receive an excused absence, students must provide appropriate documentation to the Office for Student Conduct, studentconduct@pvamu.edu.

Mapping of Program Educational Objectives onto Student Outcomes

PEO	Program Educational Objectives	CE Student Outcomes						
	<i>Graduates from the Civil Engineering program will:</i>	[1]	[2]	[3]	[4]	[5]	[6]	[7]
PEO 1	Have careers in civil engineering or related fields that lead to increasing levels of responsibility and leadership	X	X	X	X	X	X	X
PEO 2	Obtain professional licensure/certifications	X	X					
PEO 3	Complete graduate studies in civil engineering or related fields	X	X	X	X		X	X
PEO 4	Engage in professional development and service	X	X	X	X		X	X

- 1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- 2) 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 factors
- 3) an ability to communicate effectively with a range of audiences
- 4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- 5) 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
- 6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
- 7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Mapping of CE Courses and Student Outcomes [Beginning Fall 2019] Updated Fall 2021

Previous Course No.	New Course No.	Course Title	CE Student Outcomes/SOs						
			[1]	[2]	[3]	[4]	[5]	[6]	[7]
CVEG 1011	CVEG 1101	Introduction to Engineering							
CVEG 1021	CVEG 1102	Introduction to Civil Engineering Lab							I
CVEG 2043	CVEG 2301	Engineering Mechanics I							I
CVEG 2061	CVEG 2101	Materials & Dynamics Lab						I	
CVEG 2063	CVEG 2332	Mechanics of Materials I		I					
CVEG 2073	CVEG 2304	Global Development Issues {CORE}			I	√	I		R
CVEG 2081	CVEG 2102	Surveying & Geospatial Concepts			R			I	
CVEG 3023	CVEG 3300	Geotechnical Engineering		I					
CVEG 3031	CVEG 3100	Concrete & Steel Lab						√	
CVEG 3043	CVEG 3301	Environmental Engineering			R			√	
CVEG 3051	CVEG 3102	Professional Engineering I				√			
CVEG 3053	CVEG 3302	Transportation Engineering			R		√		
CVEG 3063	CVEG 3303	Hydraulics			√		R	√	
CVEG 3073	CVEG 3304	Structural Analysis I	I						√
CVEG 3083	CVEG 3305	Steel Design	√	√	R				
CVEG 4013	CVEG 4300	Reinforced Concrete	R	√					
CVEG 4021	CVEG 4100	Geotech Engineering Design Lab		R					√
CVEG 4043	CVEG 4301	Environmental Engineering Design	√	√	R				
CVEG 4053	CVEG 4302	Transportation Engineering Design	√				√		
CVEG 4063	CVEG 4303	Water Resources Engineering	√	√					I
CVEG 4093	CVEG 4304	Systems Engineering		√					√
CVEG 4472	CVEG 4200	Sr. Design & Professionalism I		√	√	√	√		√
CVEG 4482	CVEG 4201	Sr. Design & Professionalism II	√	√	√	√			

I – means the described outcome is introduced (not measured) but could be monitored.

√ - means that the skills described in the program outcome are covered and **measured** in the course.

R – means the described outcome is reinforce in the course (not measured) but could be monitored.

Additionally, evidence are to collected to satisfy **CE Program Criteria** covering basic concepts in **Management** (CVEG 3302, 4302, 4200, 4201, 4304), **Business** (CVEG 4304, 4200, 4201), **Public Policy** (CVEG 2304, 4200, 4201), **Professional Ethics** (CVEG 1102, 2304, 3102), **Leadership** (CVEG 4200, 4201), **Consideration of Sustainability** (CVEG 4301, 4302, 4303), **Importance of Professional Licensure** (CVEG 3102, 4200, 4201).

Note: Courses with a mixture of students from other Programs are intentionally excluded when possible.

The Assessment Process

Student Learning outcomes are measured using both **direct** and **indirect** measurements. Direct measurement are derived from either designated homework, tests, lab reports project reports or other assignments. Indirect measurement are drawn from end-of-semester Student Opinion Surveys (SOS) and any surveys completed by graduating Seniors. The above listed Student Learning Outcomes (Program Outcomes) are measured and evaluated in specified cycles and an Assessment Report is prepared annually for the purposes of continuously improving the Program's learning outcomes.

II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS

NONE – EFFECTIVE FALL 2021

Program Outcomes Assessed in this course

None – Effective Fall 2021

Assessment Summary of Class Semester Averages for Outcomes

None - Effective Fall 2021

End of Semester Course Assessment Reports

None - Effective Fall 2021

**MATERIALS & DYNAMICS LAB
FALL 2021**

ASSIGNMENT 1 – Exam #1-Chapters 1, 2, 3, and 4

TOPICS COVERED IN ASSIGNMENT 1

Examination I covered the following topics:

1. Chapters 1, 2, 3, 4, 5, 6, and 7
2. Stress (Normal and Shear) – Section 1.3
3. Allowable Stress Design – Section 1.6
4. Strain – Chapter 2
5. Mechanical Properties of Materials – Chapter 3
6. The Stress Strain Diagram – Section 3.2
7. Poisson's Ratio – Section 3.5
8. Axial Load – Chapter 4
9. Thermal Stress – Section 4.6
10. Torsion – Chapter 5
11. Bending stress – Chapter 6
12. Shear Formula – Section 7.2

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Exam #1 - Chapters 1, 2, 3, and 4

Given: 1 October 2021

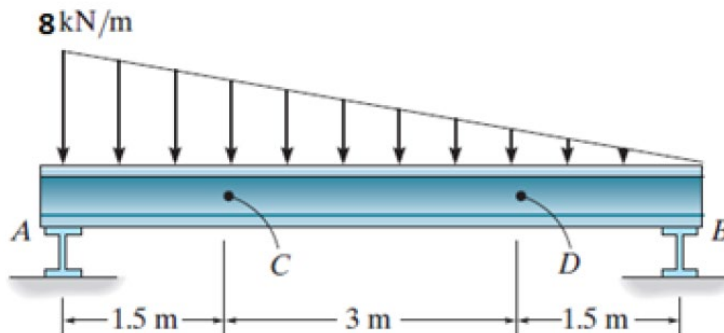
Due: 8 October 2021 at 10:05am CDT

Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

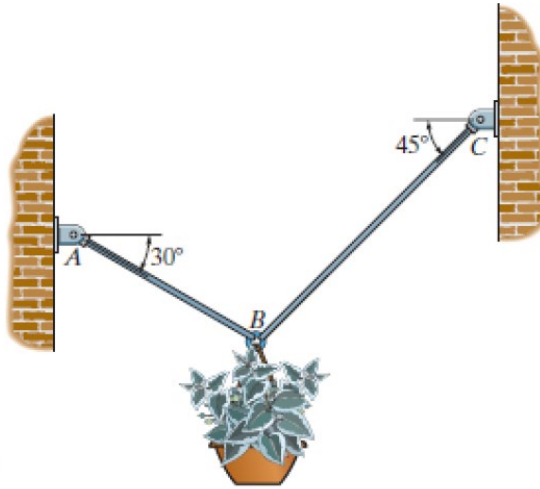
- Given
- Find
- FBD
- Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)
- A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, “Find”)

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

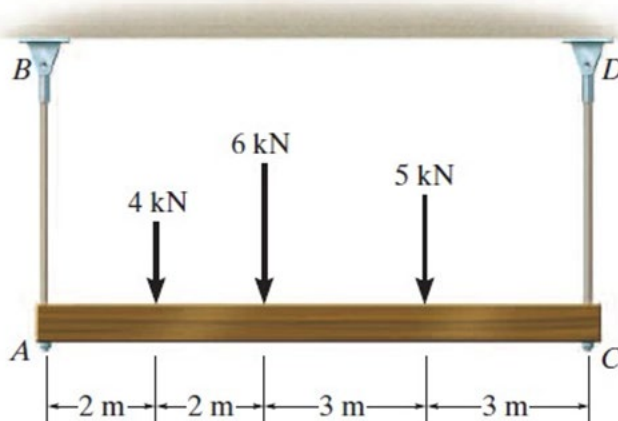
1. The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point *C*. Assume the reactions at the supports *A* and *B* are vertical. Draw all the required FBDs. [15-points]



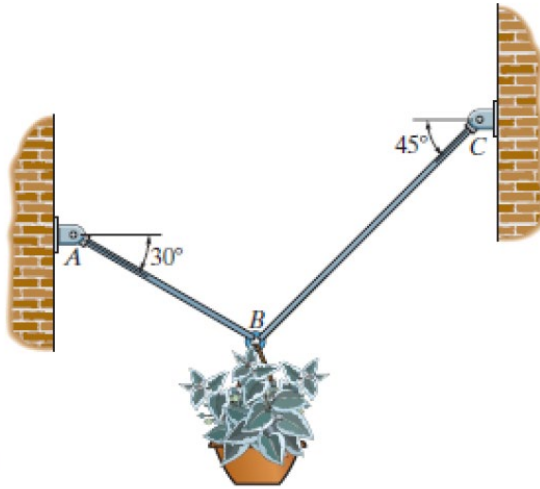
2. The 25-kg flowerpot is suspended from wires AB and BC . If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [15-points]



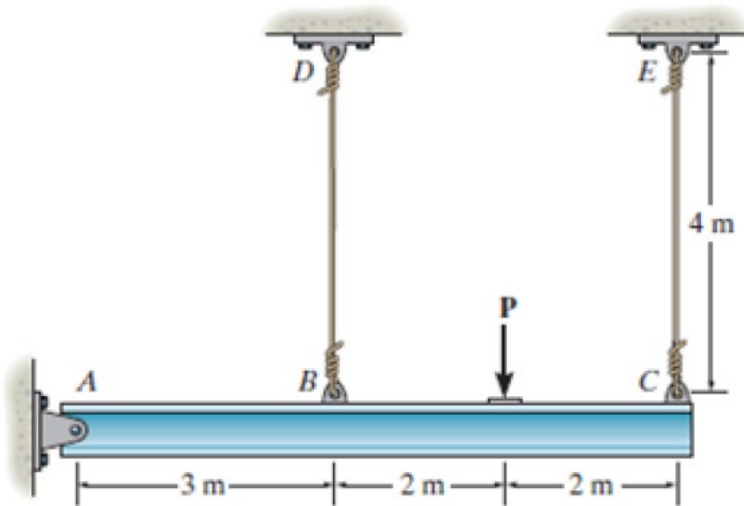
3. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{\text{fail}} = 345\text{-MPa}$. [15-points]



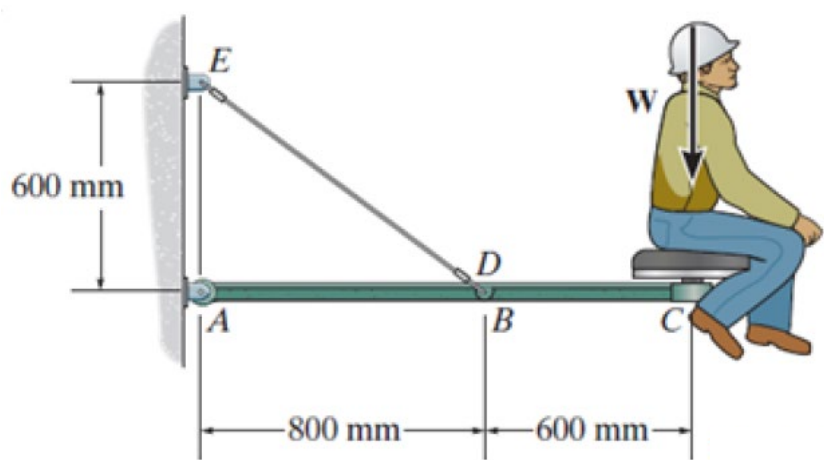
4. The 50-kg flowerpot is suspended from wires AB and BC . If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB . Use a factor of safety of 2.5. [15-points]



5. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



6. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat *C*, determine the stress on the wire *DE*. Assume Modulus of Elasticity for A-36 steel as 200-GPa. **[15-points]**



7. A steel bridge span is normally 300 meters long. What is the difference in length, in centimeter between January (-35°C) and August (40°C)? Assume coefficient of thermal expansion for steel as $11.7 \times 10^{-6} \text{ m}/(\text{m}^{\circ}\text{C})$. **[10-points]**

CVEG 2101 - Materials & Dynamics Lab
Exam #1 & #2 (Equations Sheet)

Area of a circular section

$$A = \pi r^2 \text{ Or } A = \pi d^2 / 4$$

Pythagorean Theorem

$$a^2 + b^2 = c^2$$

Normal Stress

$$\sigma = P/A$$

Shear stress

$$\tau = V/A$$

Area of section required

$$A = P/\sigma_{\text{allow}}$$

Normal strain

$$\epsilon = \Delta L/L$$

Modulus of Elasticity

$$E = \sigma / \epsilon$$

Poisson's Ratio

$$\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_a}$$

$$G = \frac{E}{2(1 + \nu)}$$

Thermal Expansion

$$\delta = \alpha \Delta T L$$

GRADING SCHEME FOR ASSIGNMENT

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Exam #1 - Chapters 1, 2, 3, and 4 – Solution (Graded Only #1 and #5-#7)

Given: 1 October 2021

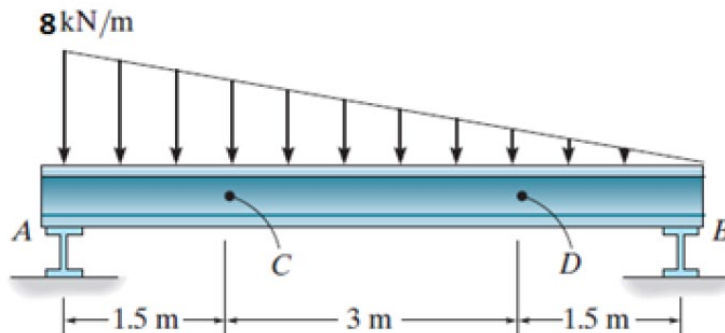
Due: 8 October 2021 at 10:05am CDT

Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

- Given
- Find
- FBD
- Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)
- A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, “Find”)

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

1. The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point *C*. Assume the reactions at the supports *A* and *B* are vertical. Draw all the required FBDs. [15-points]



To find Reactions:

$$\sum (M)_A = 0$$

$$B_y \times 6 - \left(\frac{1}{2} \times 6 \times 8\right) \times \left(\frac{1}{3} \times 6\right)$$

$$6B_y = 48$$

$$B_y = 8 \text{ kN}$$

Consider FBD of CB

$$\sum F_y = 0$$

$$V_c - \frac{1}{2} \times 4.5 \times 6 + 8 = 0$$

$$V_c - 13.5 + 8 = 0$$

$$V_c = 5.5 \text{ kN}$$

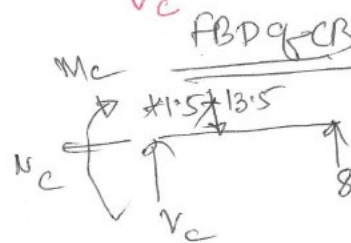
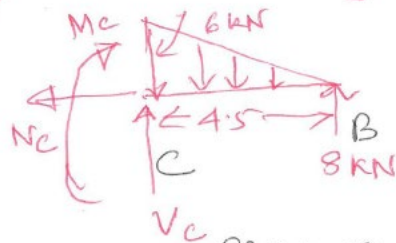
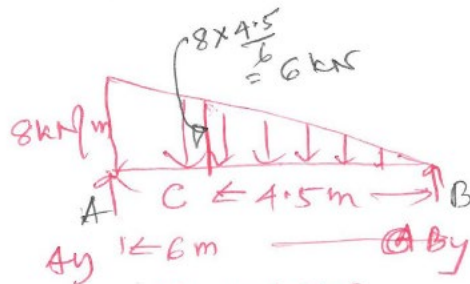
$$\sum F_x = 0 \quad N_c = 0$$

$$\sum (M)_c = 0$$

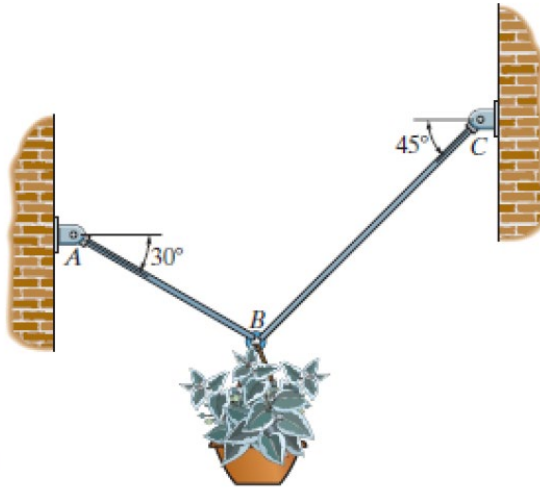
$$8 \times 4.5 - 13.5 \times 1.5 - M_c = 0$$

$$15.75 - M_c = 0$$

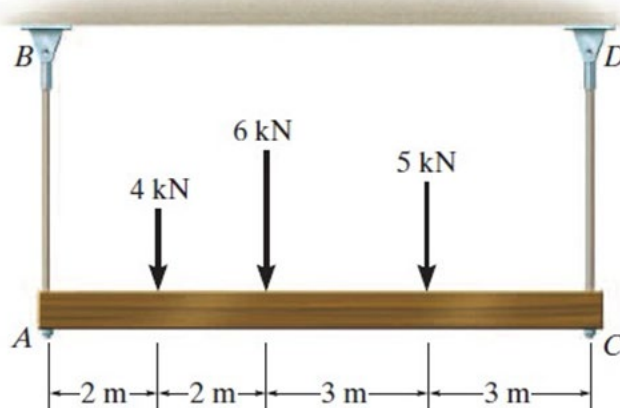
$$M_c = 15.75 \text{ kN.m}$$



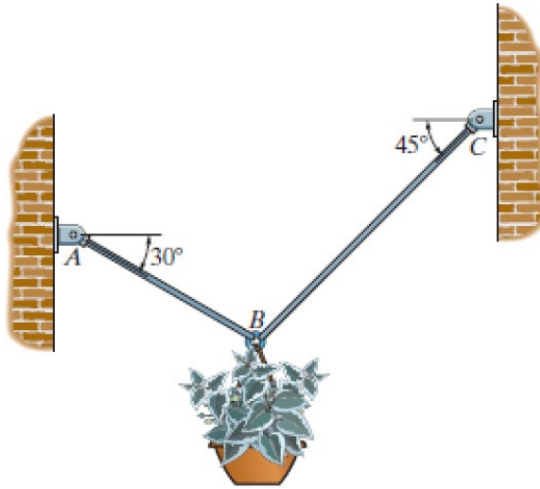
2. The 25-kg flowerpot is suspended from wires AB and BC . If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [15-points]



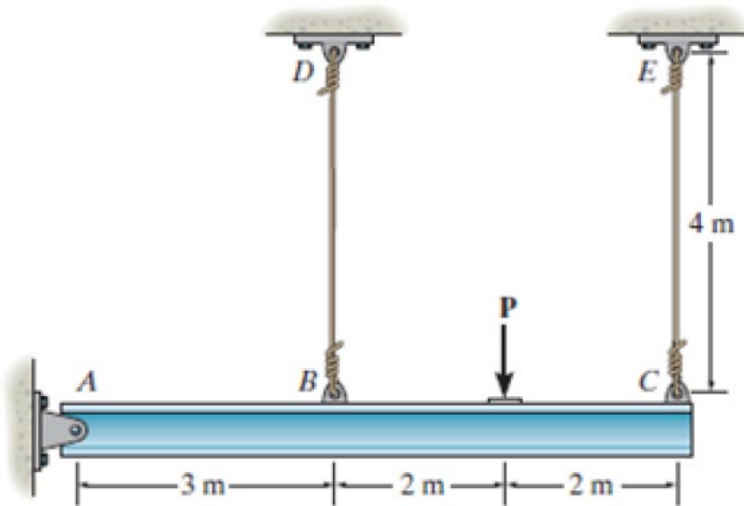
3. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{fail} = 345$ -MPa. [15-points]



4. The 50-kg flowerpot is suspended from wires AB and BC . If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB . Use a factor of safety of 2.5. [15-points]



5. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



From similar Δ 's

$ABB' \& ACC'$

$$\frac{BB'}{AB} = \frac{CC'}{AC}$$

$$\frac{BB'}{3} = \frac{5}{7}$$

$$BB' = 3 \times \frac{5}{7} = 2.14 \text{ mm}$$

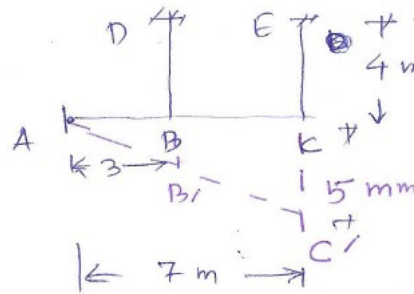
$$\delta_{CE} = 5 \text{ mm}$$

$$\delta_{BD} = 2.14 \text{ mm}$$

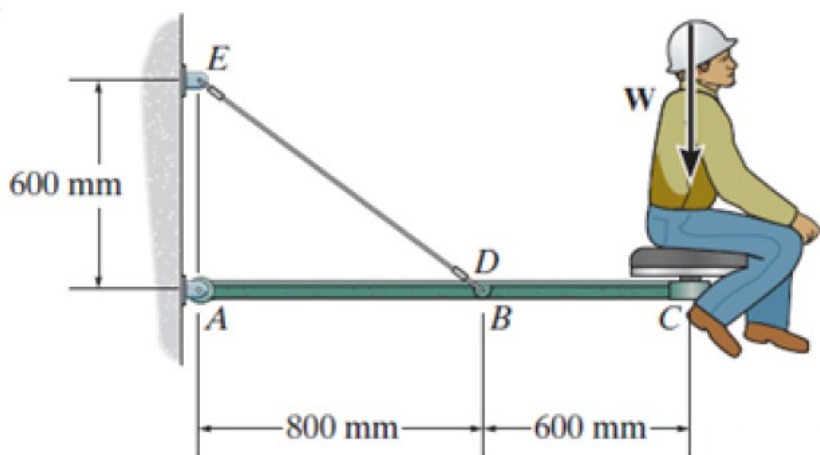
$$L_{BD} = L_{CE} = 4 \text{ m} = 4000 \text{ mm}$$

$$E_{CE} = \frac{\delta_{CE}}{L_{CE}} = \frac{5}{4000} = 1.25 \times 10^{-3}$$

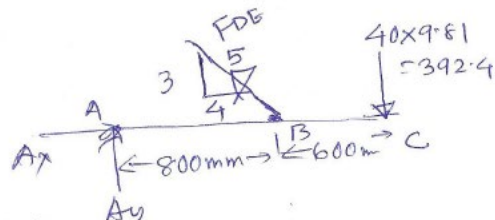
$$E_{BD} = \frac{\delta_{BD}}{L_{BD}} = \frac{2.14}{4000} = 0.535 \times 10^{-3}$$



6. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat C, determine the stress on the wire DE. Assume Modulus of Elasticity for A-36 steel as 200-GPa. [15-points]



$\sum (M)_A = 0$
 $- 392.4 \times 1400 +$
 $F_{DE} \times \frac{3}{5} \times 800 = 0$
 $F_{DE} = 1144.5 \text{ N}$
 $\sigma_{DE} = \frac{F_{DE}}{A_{DE}} = \frac{1144.5}{\frac{\pi}{4} \times (0.005)^2}$
 $= \cancel{20608 \text{ N/m}^2}$
 $= 58.29 \times 10^6 \text{ N/m}^2$
 $= \cancel{20608 \times 10^3 \text{ N/m}^2}$
 $= 58.29 \text{ MPa}$



7. A steel bridge span is normally 300 meters long. What is the difference in length, in centimeter between January (-350°C) and August (400°C)? Assume coefficient of thermal expansion for steel as $11.7 \times (10^{-6} \text{ m/(m}^\circ \text{C)})$. [10-points]

$L = 300 \text{ m}$ $\Delta T = 40^\circ - (-35^\circ)$
 $= 75^\circ \text{C}$
 $\alpha = 11.7 \times 10^{-6} / ^\circ \text{C/m}$
 $\delta = \alpha \Delta T L$
 $= 11.7 \times 10^{-6} \times 75 \times 300$
 $= 0.263 \text{ m}$
 $= 26.3 \text{ cm}$

ABOVE AVERAGE

Print Last Name Hawo
 Print Last Name Mangroo
 Print Last Name turner
 Print Last Name fontenot

Print First Name Omar
 Print First Name Ariana
 Print First Name Ulysses
 Print First Name Amani

Prairie View A&M University
 College of Engineering
 Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
 Fall 2021

Exam #1 - Chapters 1, 2, 3, and 4
 Given: 1 October 2021
 Due: 8 October 2021 at 10:05am CDT

15.5
 55
 3/15

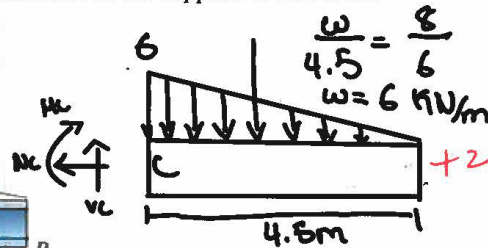
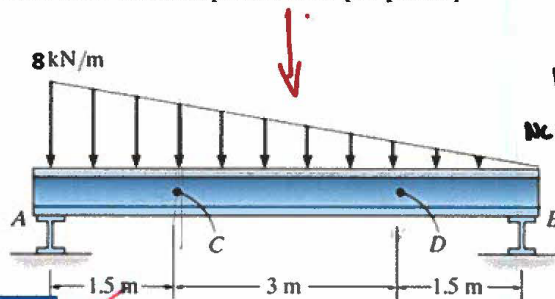
Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

- Given
- Find
- FBD
- Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)
- A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, "Find")

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

G - 1 pt
 F - 1 pt
 A - 8 pt

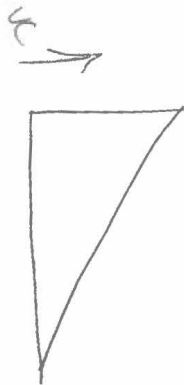
- The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point C. Assume the reactions at the supports A and B are vertical. Draw all the required FBDs. [15-points]



$$\begin{aligned} \sum F_x &= 0; N_c = 0 \\ \sum F_y &= V_c - 13.5 \\ V_c &= 13.5 \text{ kN} \quad \times -1 \\ \sum M_c &= 0; -M_c - 13.5 \text{ kN}(1.5) = 6 \\ M_c &= 20.25 \text{ kN/m} \quad \times -1 \end{aligned}$$

$$\begin{aligned} \frac{w}{4.5} &= \frac{8}{6} \\ w &= 6 \text{ kN/m} \\ F &= \frac{1}{2}(6 \text{ kN/m})(4.5) \\ F &= 13.5 \text{ kN} \\ \frac{1}{3}(4.5 \text{ m}) &= 1.5 \end{aligned}$$

48



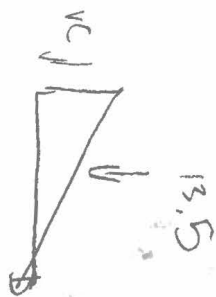
$$F_1 = V_C - 13.5 + F_D$$

$$\sum F_1 = \cancel{F_A} - 48 + F_B$$

$$F_A + F_B = 48$$

$$\sum M =$$

$$\frac{4.5}{13.5} = \frac{w}{6}$$



$$F_y: F_D - V_C = 13.5$$

$$\frac{27}{13.5} = \frac{13.5w}{13.5}$$

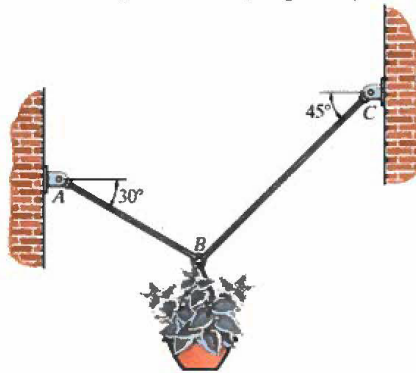
$$w = 2$$

Print Last Name HawJo
Print Last Name Mangroo
Print Last Name turner
Print Last Name fontenot

Print First Name Omar
Print First Name Ariana
Print First Name Ulysses
Print First Name Amarn

?

2. The 25-kg flowerpot is suspended from wires AB and BC . If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [15-points]



Print Last Name Hawo

Print Last Name Mangroo

Print Last Name brnel

Print Last Name fontnot

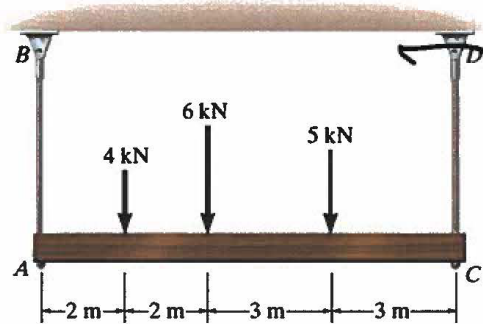
Print First Name Omar

Print First Name Ariana

Print First Name UySSCS

Print First Name Amni

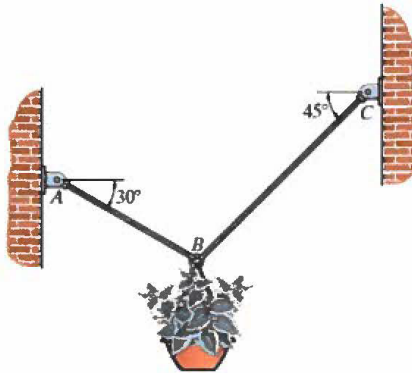
3. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{\text{fail}} = 345\text{-MPa}$. [15-points]



Print Last Name Hawto
Print Last Name Mangroo
Print Last Name Turner
Print Last Name Fontenot

Print First Name Omar
Print First Name Ariana
Print First Name Ulysses
Print First Name Amari

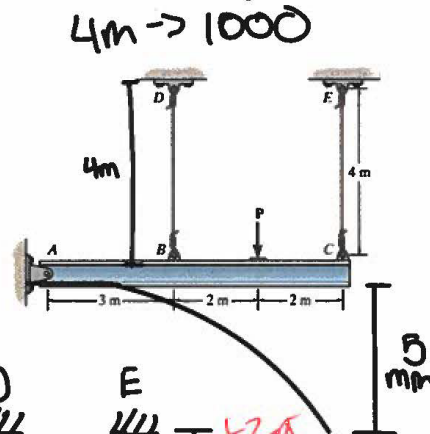
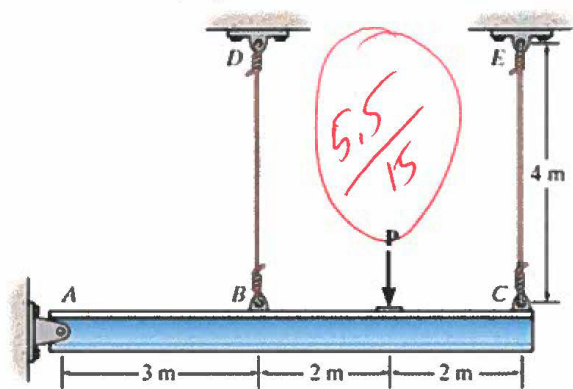
4. The 50-kg flowerpot is suspended from wires AB and BC . If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB . Use a factor of safety of 2.5. [15-points]



Print Last Name Hawo
 Print Last Name Mangroo
 Print Last Name forner
 Print Last Name fontenot

Print First Name Omar
 Print First Name Ariana
 Print First Name Olysses
 Print First Name Amani

5. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



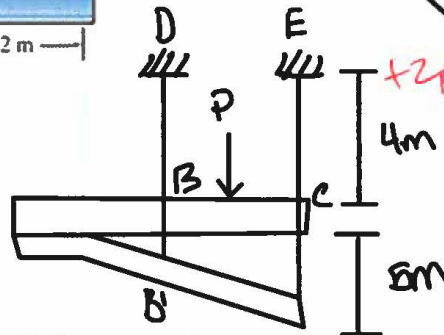
$$\frac{BB'}{5} \times \frac{3m \times 1000}{7m \times 1000}$$

$$\frac{BB' (7000)}{7000} = \frac{15000}{7000}$$

$$BB' = 2.14 \text{ mm}$$

G - 1 pt
 F - 1 pt
 Approach - 3.5

$$\Delta = ABB' \text{ and } ACC'$$



Strain in CE

$$\epsilon_{CE} = \frac{\Delta L}{L} = \frac{10 \text{ mm}}{4000 \text{ mm}} = 0.0025$$

$$\epsilon_{CE} = 0.25\%$$

Strain in BD

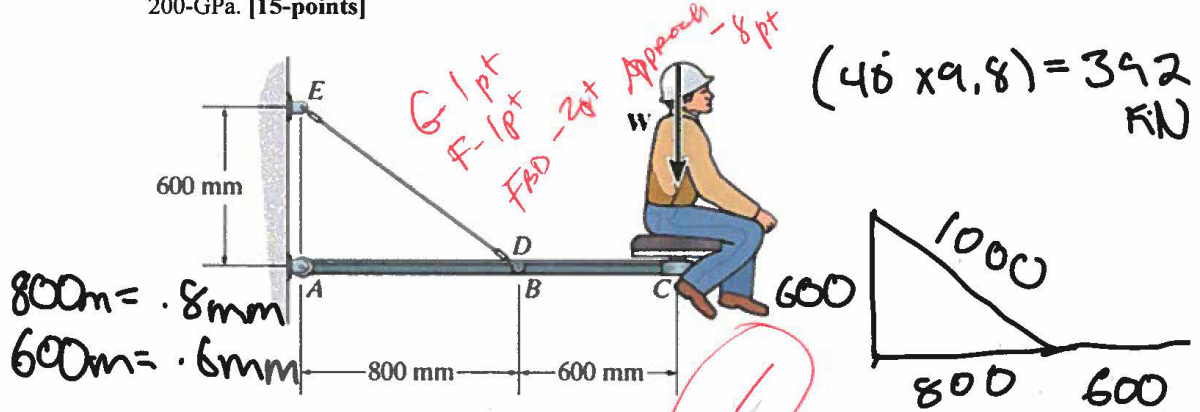
$$\epsilon_{BD} = \frac{\Delta L}{L} = \frac{2.14 \text{ mm}}{4000}$$

$$\epsilon_{BD} = 0.6535\%$$

Print Last Name Hawo
 Print Last Name Harwood
 Print Last Name Turner
 Print Last Name Fontenot

Print First Name Omer
 Print First Name Ariana
 Print First Name Olysses
 Print First Name Amani

6. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat C, determine the stress on the wire DE. Assume Modulus of Elasticity for A-36 steel as 200-GPa. [15-points]



$$\sum M = 0$$

$$F_{DE} \times \left(\frac{3}{5}\right) (0.8) - 40(9.8)(1.4) = 0$$

$$F_{DE} (0.48) - 549.36 = 0$$

$$\frac{F_{DE} (0.48)}{0.48} = \frac{549.36}{0.48}$$

$$F_{DE} = 1144.5$$

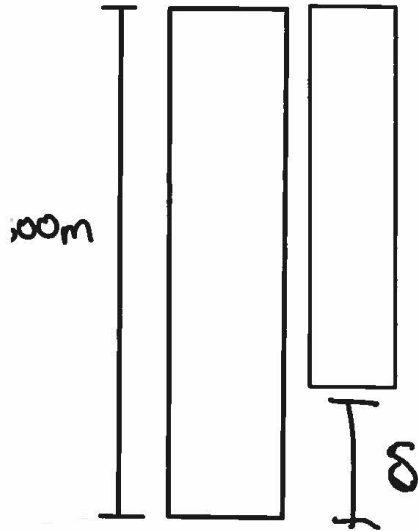
$$\sigma = \frac{F}{A} = \frac{1144.5}{\frac{\pi (0.005)^2}{4}} = 58288906.359$$

$$\sigma = 582.88 \text{ MPa}$$

Print Last Name Hawo
 Print Last Name Mangroo
 Print Last Name Turner
 Print Last Name Ponterot

Print First Name Omer
 Print First Name Ariana
 Print First Name Ulysses
 Print First Name Amani

7. A steel bridge span is normally 300-meters long. What is the difference in length, in centimeter between January (-350° C) and August (400° C)? Assume coefficient of thermal expansion for steel as $11.7 \times 10^{-6} \text{ m/(m } ^\circ\text{C)}$. [10-points]



$$T_1 = -350^\circ\text{C}$$

$$T_2 = 400^\circ\text{C}$$

Thermal Expansion

$$\delta = \alpha \Delta T L$$

Annotations: δ is labeled 'Change', α is labeled 'm/m°C', ΔT is labeled 'The change in Temp of the member', and L is labeled 'original length'.

$$\delta = (11.7 \times 10^{-6}) (400 - (-350)) (300\text{m})$$

$$\delta = (11.7 \times 10^{-6}) (750) (300) \checkmark$$

$$\delta = 2.6325\text{m}$$

$\checkmark +3$

Begin decimal place -1pt

G+1pt

F-1pt

FB12 + 2pt

Apparent 3pt

7/10

CVEG 2101 - Materials & Dynamics Lab
Exam #1 (Equations Sheet)

Area of a circular section
 $A = \pi r^2$ Or $A = \pi d^2/4$

Pythagorean Theorem
 $a^2 + b^2 = c^2$

Normal Stress
 $\sigma = P/A$

$$E = \frac{\sigma}{\epsilon}$$

Shear stress
 $\tau = V/A$

Area of section required
 $A = P/\sigma_{\text{allow}}$

$$2\sigma \times \epsilon = \sigma$$

Normal strain
 $\epsilon = \Delta L/L$

Modulus of Elasticity
 $E = \sigma/\epsilon$

Poisson's Ratio
 $\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_a}$

$$G = \frac{E}{2(1 + \nu)}$$

Thermal Expansion
 $\delta = \alpha \Delta T L$

AVERAGE

NO AVERAGE STUDENT WORK SAMPLE FOR EXAM #1

BELOW AVERAGE

Prairie View A&M University



11.5
55

CVEG 2101: P81

Materials and Dynamics Lab

Section: P81

Exam #1

Assigned: September 30, 2021

Due: October 8, 2021

Submitted By: Tamia Ford, Erik Smith, Marshall Johnson

Submitted to: Dr. Perkins, Professor Md Alam

Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Exam #1 - Chapters 1, 2, 3, and 4

Given: 1 October 2021

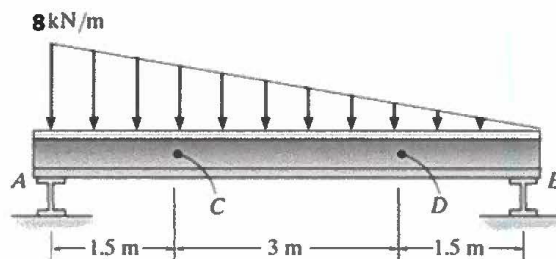
Due: 8 October 2021 at 10:05am CDT

Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

- **Given**
- **Find**
- **FBD**
- **Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)**
- **A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, "Find")**

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

1. The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point C. Assume the reactions at the supports A and B are vertical. Draw all the required FBDs. [15-points]



Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

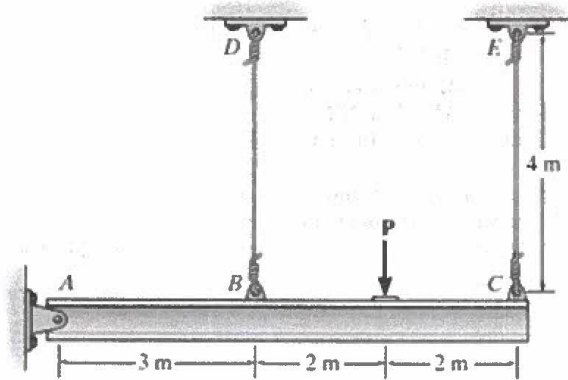
Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

5. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

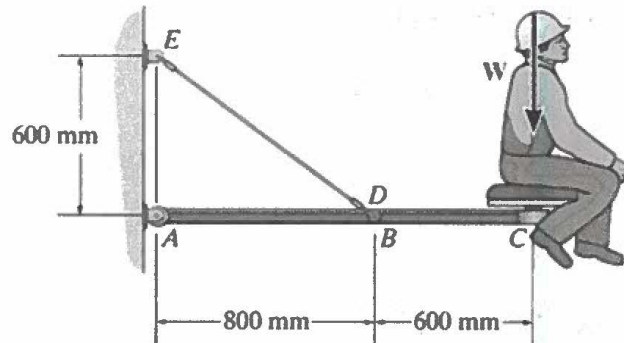
Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

6. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat C, determine the stress on the wire DE . Assume Modulus of Elasticity for A-36 steel as 200-GPa. [15-points]



Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

Print Last Name _____

Print First Name _____

7. A steel bridge span is normally 300-meters long. What is the difference in length, in centimeter between January (-350°C) and August (400°C)? Assume coefficient of thermal expansion for steel as $11.7 \times 10^{-6} \text{ m/(m }^{\circ}\text{C)}$. [10-points]

Length of Bridge in Jan.

$$= L \{1 - [11.7 \times 10^{-6} (T - (-350))]\}$$

Length in Aug.

$$= L \{1 + [11.7 \times 10^{-6} (40 - T)]\}$$

Δ in length btw Jan. & Aug.

$$= L \times = L \cdot 11.7 \times 10^{-6} (40 - T + T + 350)$$

$$L = 300\text{m}$$

$$= 300 \times 11.7 \times 10^{-6} (750)$$

$$= .26325\text{m}$$

$$\approx 26\text{ cm} \quad +3 \quad -1\text{pt}$$

G - 1pt
F - 1pt

FBD - 2pt

Approach + 3pt

5/10

Exam #1

#1

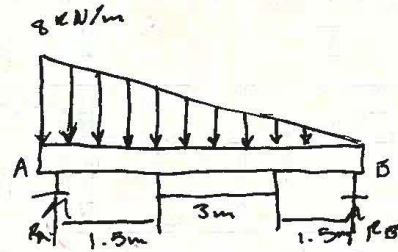
$$\sum F_y = 0$$

$$R_A + R_B = \frac{1}{2} \times 6 \times 8 = 24 \text{ kN}$$

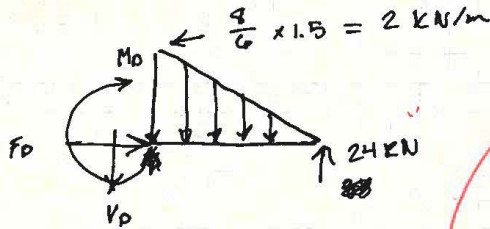
$$\sum M_A = 0$$

$$R_B \times 6 - \frac{1}{2} \times 6 \times 8 \times \frac{1}{3} \times 6 = 0$$

$$R_B = 24 \text{ kN} \quad R_A = 0 \text{ kN}$$



Cross section



$$\sum F_y = 0$$

$$-V_D - \frac{1}{2} \times 1.5 \times 2 + 24 = 0$$

$$V_D = 0$$

$$\sum M_D = 0$$

$$8 \times 1.5 - \frac{1}{2} \times 1.5 \times 2 \times \frac{1}{3} \times 1.5 - M_D = 0$$

$$M_D = 5.625 \text{ kN-m}$$

$$F_D = 0$$

G-1 pt
F-1 pt
FBD-2 pt
Answer 1-8
Answer-3



Exam #1

#5

$$\tan \theta = \frac{s_B}{3} = \frac{s_C}{7}$$

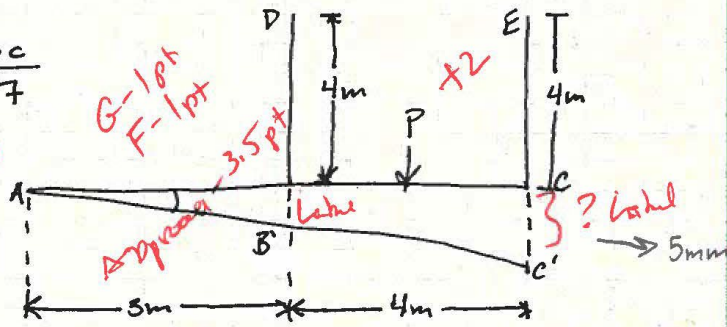
$$s_C = \frac{7}{3} s_B$$

$$= \frac{7}{3} \times 5$$

$$s_C = 11.666 \text{ mm}$$

$$E_{CE} = \frac{s_C}{L_{EC}} = \frac{11.666 \text{ mm}}{4000 \text{ mm}}$$

$$E_{CE} = 2.917 \times 10^{-3}$$

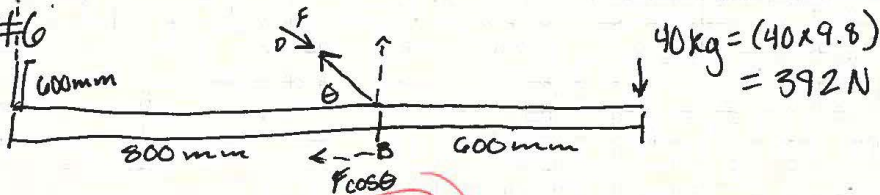


$$E_{BD} = \frac{5 \text{ mm}}{4000 \text{ mm}} = 1.25 \times 10^{-3}$$

$$E_{BD} = 1.25 \times 10^{-3}$$

$$\frac{6.5}{15}$$

#6



$$\sum M_A = 0$$

$$392 \times 1400 - F \sin \theta = 800$$

$$F \sin \theta = \frac{392 \times 1400}{800} = 686 \text{ N}$$

Elongation @ wire D

$$\Rightarrow \frac{F \times \text{length of wire}}{\text{cross section} \times \text{Mod. of Elas.}} \Rightarrow \frac{686 \times 1000}{\frac{\pi}{4} \times 9^2 \times 200 \times 1000}$$

$$= .17469 \text{ mm}$$

x-2pt

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 2 – Exam #2-Chapters 1, 2, 3, and 4 (Retake of Exam #1)

TOPICS COVERED IN ASSIGNMENT 2

Examination 2 covered the following topics:

1. Chapters 1, 2, 3, 4, 5, 6, and 7
2. Stress (Normal and Shear) – Section 1.3
3. Allowable Stress Design – Section 1.6
4. Strain – Chapter 2
5. Mechanical Properties of Materials – Chapter 3
6. The Stress Strain Diagram – Section 3.2
7. Poisson's Ratio – Section 3.5
8. Axial Load – Chapter 4
9. Thermal Stress – Section 4.6
10. Torsion – Chapter 5
11. Bending stress – Chapter 6
12. Shear Formula – Section 7.2

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Exam #2 - Chapters 1, 2, 3, and 4 (Retake of Exam #1)

Given: 19 November 2021

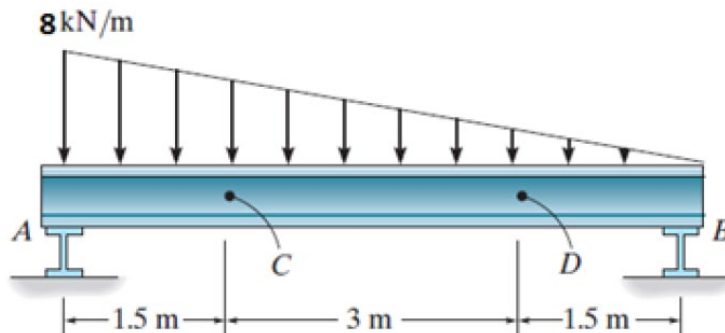
Due: 19 November 2021 at 1pm CST

Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

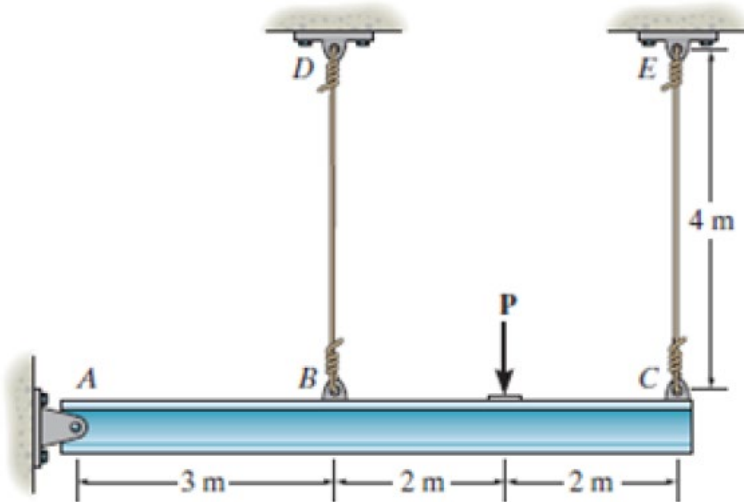
- Given
- Find
- FBD
- Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)
- A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, “Find”)

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

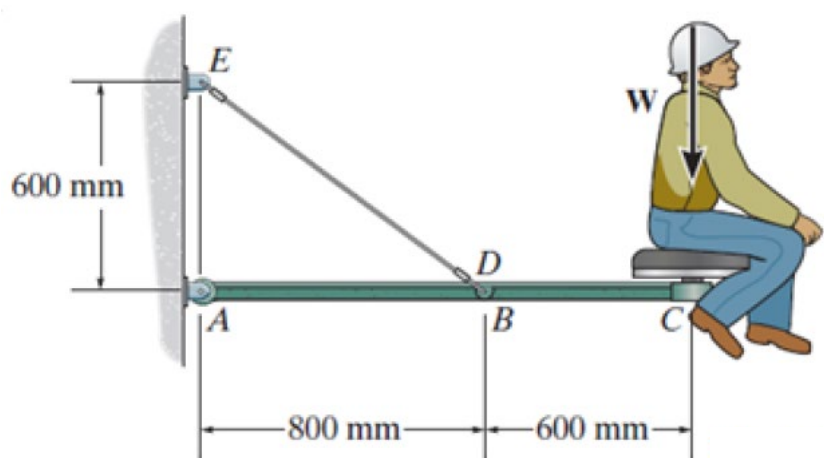
1. The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point *C*. Assume the reactions at the supports *A* and *B* are vertical. Draw all the required FBDs. [15-points]



2. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



3. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat C , determine the stress on the wire DE . Assume Modulus of Elasticity for A-36 steel as 200-GPa. [15-points]



4. A steel bridge span is normally 300 meters long. What is the difference in length, in centimeter between January (-350°C) and August (400°C)? Assume coefficient of thermal expansion for steel as $11.7 \times (10^{-6} \text{ m}/(\text{m}^{\circ}\text{C}))$. [10-points]

CVEG 2101 - Materials & Dynamics Lab
Exam #1 & #2 (Equations Sheet)

Area of a circular section

$$A = \pi r^2 \text{ Or } A = \pi d^2 / 4$$

Pythagorean Theorem

$$a^2 + b^2 = c^2$$

Normal Stress

$$\sigma = P/A$$

Shear stress

$$\tau = V/A$$

Area of section required

$$A = P/\sigma_{\text{allow}}$$

Normal strain

$$\epsilon = \Delta L/L$$

Modulus of Elasticity

$$E = \sigma / \epsilon$$

Poisson's Ratio

$$\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_a}$$

$$G = \frac{E}{2(1 + \nu)}$$

Thermal Expansion

$$\delta = \alpha \Delta T L$$

GRADING SCHEME FOR ASSIGNMENT

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Exam #2 - Chapters 1, 2, 3, and 4 (Retake of Exam #1) - Solution

Given: 19 November 2021

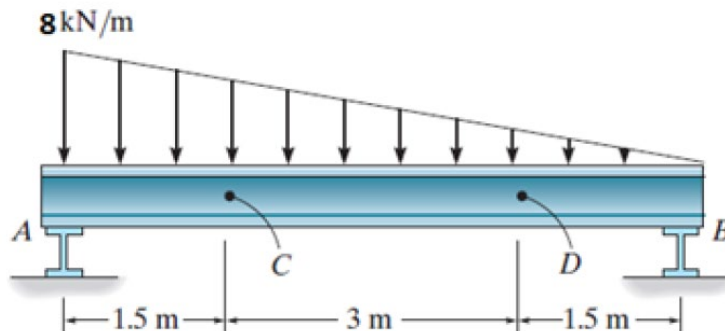
Due: 19 November 2021 at 1pm CST

Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

- Given
- Find
- FBD
- Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)
- A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, “Find”)

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

1. The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point *C*. Assume the reactions at the supports *A* and *B* are vertical. Draw all the required FBDs. [15-points]



To find Reactions:

$$\sum (M)_A = 0$$

$$B_y \times 6 - \left(\frac{1}{2} \times 6 \times 8\right) \times \left(\frac{1}{3} \times 6\right)$$

$$6B_y = 48$$

$$B_y = 8 \text{ kN}$$

Consider FBD of CB

$$\sum F_y = 0$$

$$V_c - \frac{1}{2} \times 4.5 \times 6 + 8 = 0$$

$$V_c - 13.5 + 8 = 0$$

$$V_c = 5.5 \text{ kN}$$

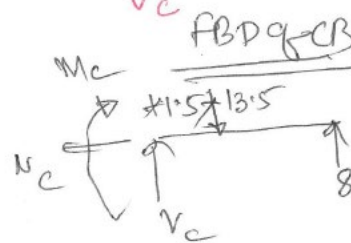
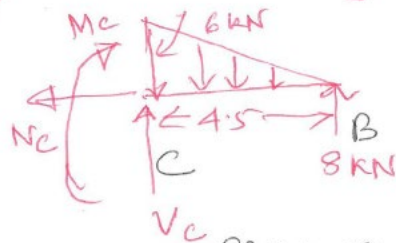
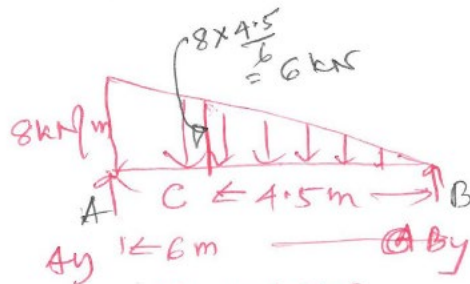
$$\sum F_x = 0 \quad N_c = 0$$

$$\sum (M)_c = 0$$

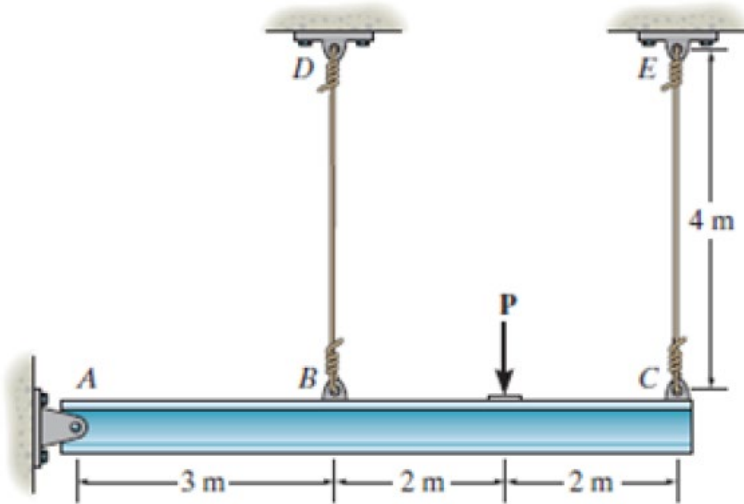
$$8 \times 4.5 - 13.5 \times 1.5 - M_c = 0$$

$$15.75 - M_c = 0$$

$$M_c = 15.75 \text{ kN.m}$$



2. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



From similar Δ 's

$ABB' \& ACC'$

$$\frac{BB'}{AB} = \frac{CC'}{AC}$$

$$\frac{BB'}{3} = \frac{5}{7}$$

$$BB' = 3 \times \frac{5}{7} = 2.14 \text{ mm}$$

$$\delta_{CE} = 5 \text{ mm}$$

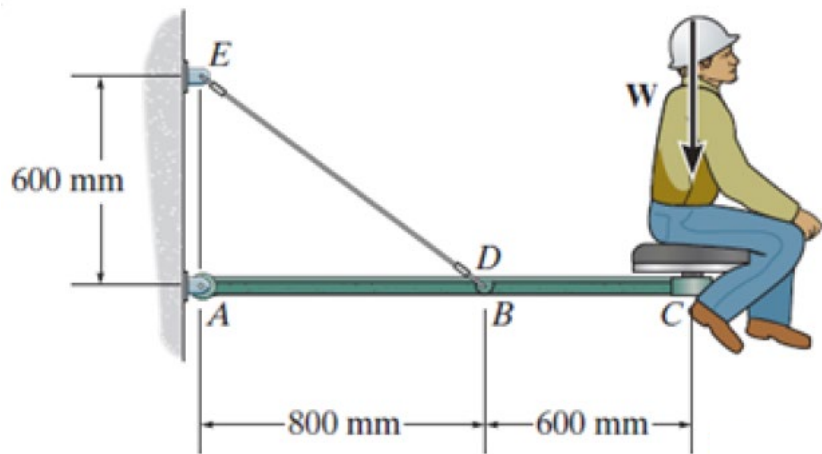
$$\delta_{BD} = 2.14 \text{ mm}$$

$$L_{BD} = L_{CE} = 4 \text{ m} = 4000 \text{ mm}$$

$$\epsilon_{CE} = \frac{\delta_{CE}}{L_{CE}} = \frac{5}{4000} = 1.25 \times 10^{-3}$$

$$\epsilon_{BD} = \frac{\delta_{BD}}{L_{BD}} = \frac{2.14}{4000} = 0.535 \times 10^{-3}$$

3. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat C, determine the stress on the wire *DE*. Assume Modulus of Elasticity for A-36 steel as 200-GPa. [15-points]



$$\begin{aligned}
 \sum \mathcal{M}_A &= 0 \\
 - 392.4 \times 1400 + F_{DE} \times \frac{3}{5} \times 800 &= 0 \\
 F_{DE} &= 1144.5 \text{ N} \\
 \sigma_{DE} &= \frac{F_{DE}}{A_{DE}} = \frac{1144.5}{\frac{\pi}{4} \times (0.005)^2} \\
 &= \cancel{20608 \text{ N/m}^2} \\
 &= 58.29 \times 10^6 \text{ N/m}^2 \\
 &= \cancel{20608 \times 10^3 \text{ N/m}^2} \\
 &= 58.29 \text{ MPa}
 \end{aligned}$$

4. A steel bridge span is normally 300 meters long. What is the difference in length, in centimeter between January (-35°C) and August (40°C)? Assume coefficient of thermal expansion for steel as $11.7 \times 10^{-6} \text{ m}/(\text{m}^{\circ}\text{C})$. **[10-points]**

$$L = 300 \text{ m} \quad \Delta T = 40^{\circ} - (-35^{\circ})$$
$$= 75^{\circ}\text{C}$$

$$\alpha = 11.7 \times 10^{-6} / ^{\circ}\text{C}/\text{m}$$

$$\delta = \alpha \Delta T L$$

$$= 11.7 \times 10^{-6} \times 75 \times 300$$

$$= 0.263 \text{ m}$$

$$= 26.3 \text{ cm}$$

ABOVE AVERAGE

NO ABOVE AVERAGE STUDENT WORK SAMPLE FOR EXAM #2

AVERAGE

Print Last Name Enano Cruz

Print First Name _____

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Exam #2 - Chapters 1, 2, 3, and 4 (Retake of Exam #1)

Given: 19 November 2021

Due: 19 November 2021 at 1pm CST

Instructions: You will need to submit your responses below each question. If you need additional space, please use the backside of the paper. Your numerical answer should not go beyond two places after the decimal point. The format for submitting your responses to each problem is as follows:

- Given
- Find
- FBD
- Approach/Step-by-Step Calculations (This shows your Approach to Solving the Problem)
- A Block Drawn Around the Answer or Answers (Reference what you have listed under the category entitled, "Find")

You must label each section of the format shown above. Deviation from the prescribed format outlined above for submitting your response to each problem will result in a grade of zero for that particular problem.

1. The beam supports the distributed load shown. Determine the resultant internal loadings acting on the cross section at point C. Assume the reactions at the supports A and B are vertical. Draw all the required FBDs. [15-points]

Given:

AC = 1.5 m

CD = 3 m

DB = 1.5 m

Find:

the resultant internal loadings at the cross-section of point C

Approach:

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

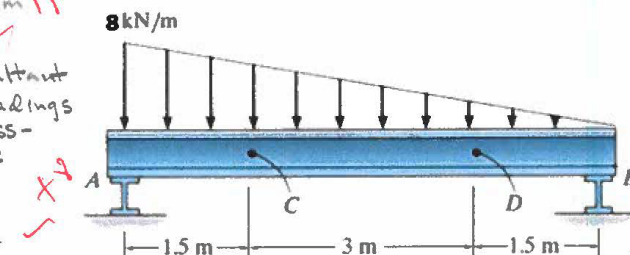
$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

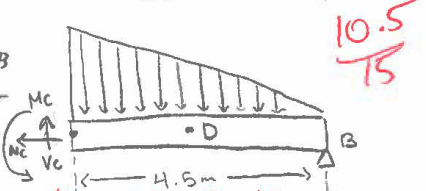
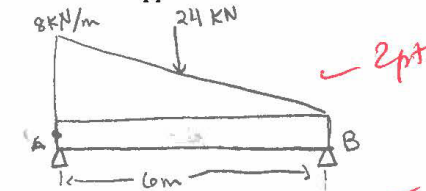
$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$

$\frac{2}{1.5} = \frac{8}{6}$



FBD:



$$\left(\frac{1}{2}\right)b \cdot h = \frac{1}{2}(4.5)(6) = 13.5; \quad \frac{1}{3}(4.5) = 1.5$$

$$\sum F_x = 0$$

$$\sum F_y = 0$$

$$V_c + 8 = 13.5$$

$$V_c = 5.5 \text{ kN}$$

$$\sum M = 0$$

$$-M_c + 13.5 \text{ kN}(2) - 8(4.5) = 0$$

$$+M_c$$

$$9 \text{ kN} = M_c$$

$$V_c = 5.5 \text{ kN}$$

$$M_c = 9 \text{ kN}$$

$$V_c = 5.5 \text{ kN}$$

$$M_c = 9 \text{ kN}$$

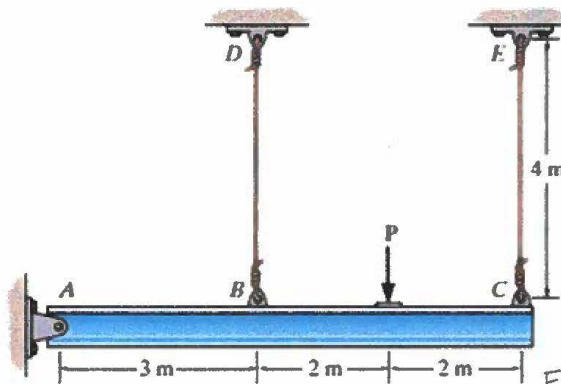
math error - 2pts

Units incorrect - 1pt

Print Last Name _____

Print First Name _____

2. The rigid beam is supported by a pin at A and wires BD and CE . If the load P on the beam causes the end C to be displaced 5-mm downward, determine the normal strain developed in wires CE and BD . [15-points]



Given:

- Rigid beam supported by pin at A and wires BD and CE
- Load P on beam causes the end C to be displaced 5-mm downward

Find:

- The normal strain developed in wires CE and BD

Approach:

$$\tan \theta = \frac{\delta_B}{3} = \frac{\delta_C}{7}$$

$$\frac{\delta_B}{3} = \left(\frac{3m}{7m} \right) \times \left(\frac{1000}{1000} \right)$$

$$\frac{\delta_B (7000)}{7000} = \frac{15,000}{7,000}$$

$$\delta_B = 2.14 \text{ mm} \approx 0.00214 \text{ m}$$

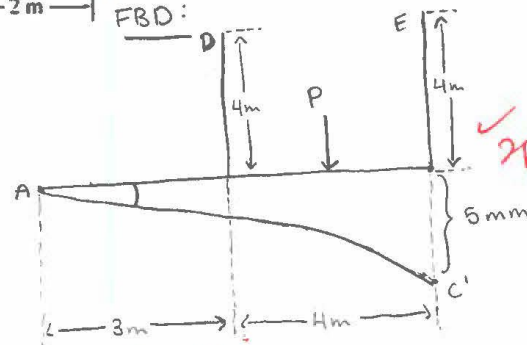
Strain in CE :

$$\epsilon_{CE} = \frac{\Delta L}{L} = \frac{10,000 \text{ mm}}{4000 \text{ mm}} = 2.5 \text{ mm}$$

Strain in BD :

$$\epsilon_{BD} = \frac{\Delta L}{L} = \frac{2.14 \text{ mm}}{4000 \text{ mm}} = 0.000535 \text{ mm} = 5.4 \times 10^{-4} \text{ mm}$$

FBD:



2pt

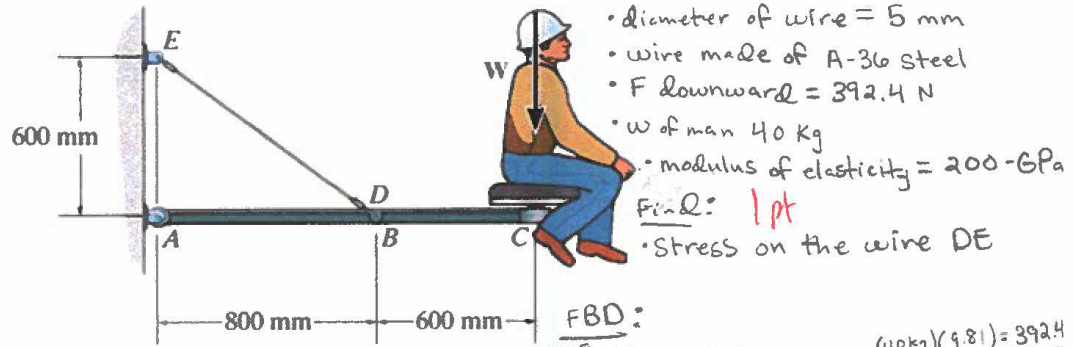
Math error -2pt

4/15

Print Last Name _____

Print First Name _____

3. The wire has a diameter of 5-mm and is made from A-36 steel. If a 40-kg man is sitting on seat C, determine the stress on the wire DE. Assume Modulus of Elasticity for A-36 steel as 200-GPa. [15-points]



Approach: ✗ 8

$$\sum M_A = 0$$

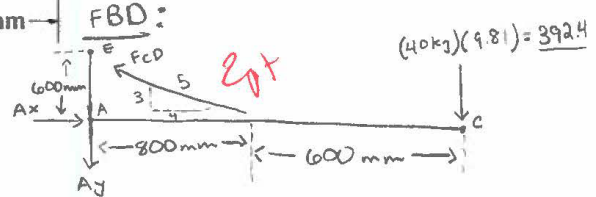
$$F_{DE} \left(\frac{3}{5} \right) 800 - [392.4 \text{ N} \times 1400] = 0$$

$$F_{DE} (480) - 549,360 = 0$$

$$\frac{480 F_{DE}}{480} = \frac{549,360}{480}$$

$$F_{DE} = 1,144.5$$

$$\sigma = \frac{F}{A} = \frac{1,144.5}{\frac{\pi}{4} (5)^2} = \boxed{58.29 \text{ MPa}} \quad \text{✗ 3}$$



Print Last Name _____

Print First Name _____

4. A steel bridge span is normally 300 meters long. What is the difference in length, in centimeter between January (-350°C) and August (400°C)? Assume coefficient of thermal expansion for steel as $11.7 \times 10^{-6} \text{ m}/(\text{m}^{\circ}\text{C})$. [10-points]

Given:

- Co-eff of thermal expansion = $11.7 \times 10^{-6} \text{ m}/(\text{m}^{\circ}\text{C})$
- Span of bridge = 300 m
- $T_1 = -350^{\circ}\text{C}$
- $T_2 = 400^{\circ}\text{C}$

ind:

Change in length between (T_1) and (T_2) [δ]

approach:

$$\delta = \alpha \times \Delta T \times L$$

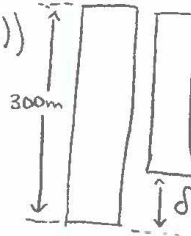
$$= \left(\text{const.} \right) \times \left(\text{change in temp of member} \right) \times \left(\text{original Length} \right)$$

↓

$$\delta = (11.7 \times 10^{-6}) \times (400 - (-350)) \times (300 \text{ m})$$

$$= 0.27 \text{ m}$$

FBD:



+2P

+3

10/10

CVEG 2101 - Materials & Dynamics Lab
Exam #2 (Equations Sheet)

Area of a circular section
 $A = \pi r^2$ Or $A = \pi d^2/4$

Pythagorean Theorem
 $a^2 + b^2 = c^2$

Normal Stress
 $\sigma = P/A$

Shear stress
 $\tau = V/A$

Area of section required
 $A = P/\sigma_{\text{allow}}$

Normal strain
 $\epsilon = \Delta L/L$

Modulus of Elasticity
 $E = \sigma/\epsilon$

Poisson's Ratio
$$\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_a}$$

$$G = \frac{E}{2(1 + \nu)}$$

Thermal Expansion
 $\delta = \alpha \Delta T L$

BELOW AVERAGE

NO BELOW AVERAGE STUDENT WORK SAMPLE FOR EXAM #2

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 1 – Homework Assignment #1 - Chapters 1-4

TOPICS COVERED IN HOMEWORK ASSIGNMENT 1

Homework Assignment 1 covered the following topics:

1. Internal Resultant Loading
2. Normal and Shear Stress
3. Equilibrium of a Deformable Body
4. Limit State Design
5. Load and Resistance Factor Design

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #1 – Chapters 1-4

Given: 15 October 2021

Due: 15 October 2021 NLT 12:50pm CDT

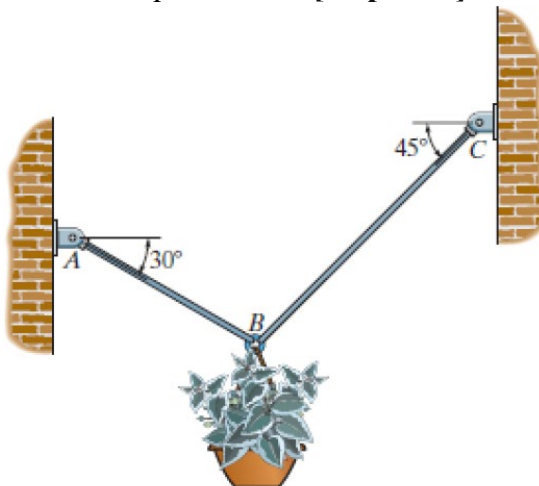
Assignment Point Value is – 60 points

Instructions: This is a **GROUP ASSIGNMENT**. You will need to submit your responses below each problem. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

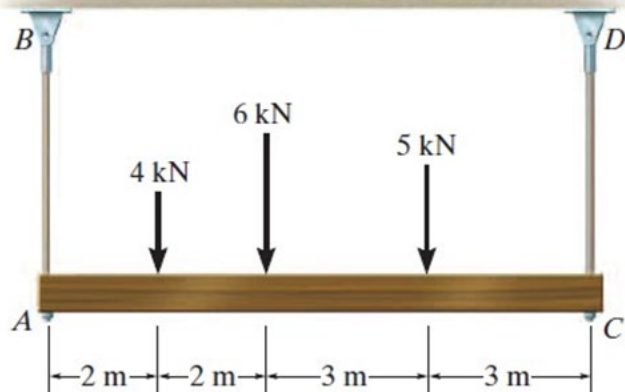
- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

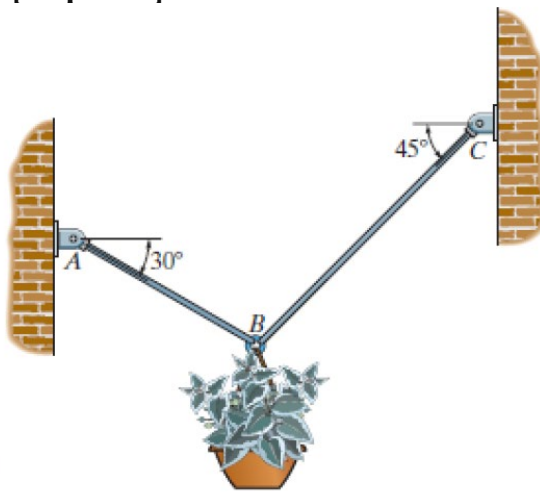
1. The 25-kg flowerpot is suspended from wires AB and BC . If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [20-points]



2. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{\text{fail}} = 345\text{-MPa}$. [20-points]



3. The 50-kg flowerpot is suspended from wires AB and BC . If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB . Use a factor of safety of 2.5. [20-points]



GRADING SCHEME FOR ASSIGNMENT

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Homework Assignment #1 – Chapters 1-4 - Solution

Given: 15 October 2021

Due: 15 October 2021 NLT 12:50pm CDT

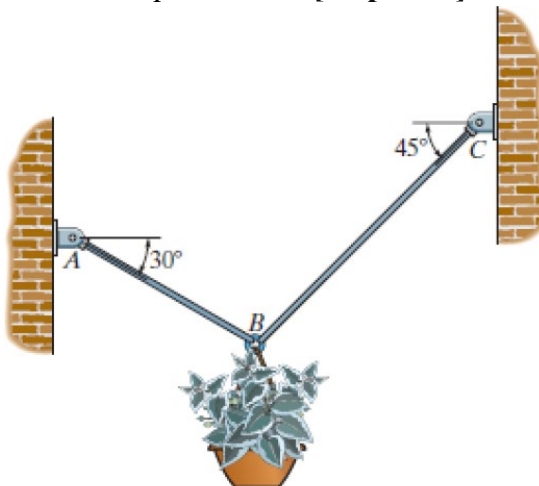
Assignment Point Value is – 60 points

Instructions: This is a **GROUP ASSIGNMENT**. You will need to submit your responses below each problem. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. The 25-kg flowerpot is suspended from wires AB and BC . If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [20-points]



$$\rightarrow \sum F_x = 0$$

$$F_{BC} \cos 45^\circ - F_{BA} \cos 30^\circ = 0$$

$$0.707 F_{BC} - 0.867 F_{BA} = 0 \quad \text{--- (1)}$$

$$\uparrow \sum F_y = 0$$

$$F_{BC} \sin 45^\circ + F_{BA} \sin 30^\circ - 245.25 = 0$$

$$0.707 F_{BC} + 0.5 F_{BA} = 245.25 \quad \text{--- (2)}$$

Solving (1) & (2)

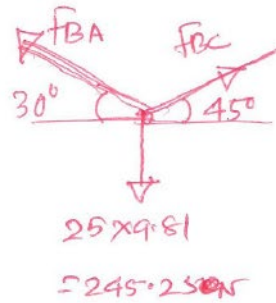
$$F_{BA} = 179.53 \text{ N}$$

$$A_{BA} \times 140 \times 10^6 = 179.53$$

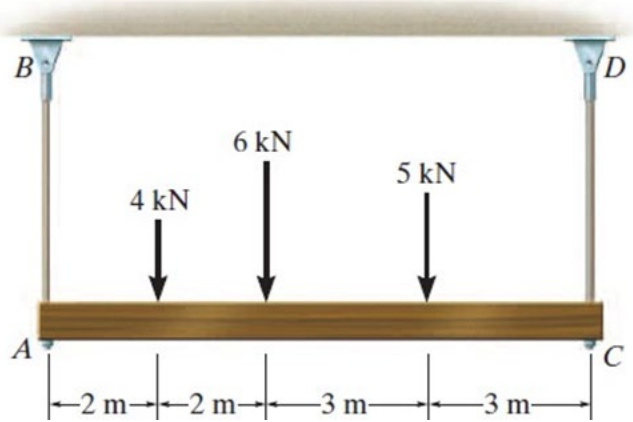
$$A_{BA} = \frac{179.53}{140 \times 10^6}$$

$$= 1.28 \times 10^{-6} \text{ m}^2$$

$$\boxed{A_{BA} = 1.28 \text{ mm}^2}$$



2. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{fail} = 345\text{-MPa}$. [20-points]



2

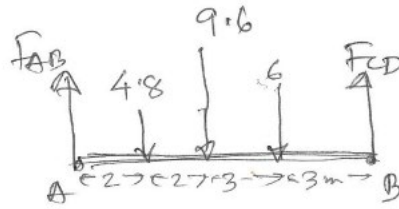
factor of ^{dead} loads

$$1.2 \times 4 = 4.8 \text{ kN}$$

$$1.2 \times 5 = 6 \text{ kN}$$

factored live load

$$1.6 \times 6 = 9.6 \text{ kN}$$

F_{BD}

$$\sum (M)_A = 0$$

$$F_{BD} \times 10 - 6 \times 7 - 9.6 \times 4 - 4.8 \times 2 = 0$$

$$10 F_{BD} = 90$$

$$F_{BD} = 9 \text{ kN}$$

$$\sum F_y = 0$$

$$F_{BD} + F_{AB} - 4.8 - 9.6 - 6 = 0$$

$$9 + F_{AB} - 4.8 - 9.6 - 6 = 0$$

$$F_{AB} = 11.4 \text{ kN}$$

$$\phi P_n = \sum A_i f_i$$

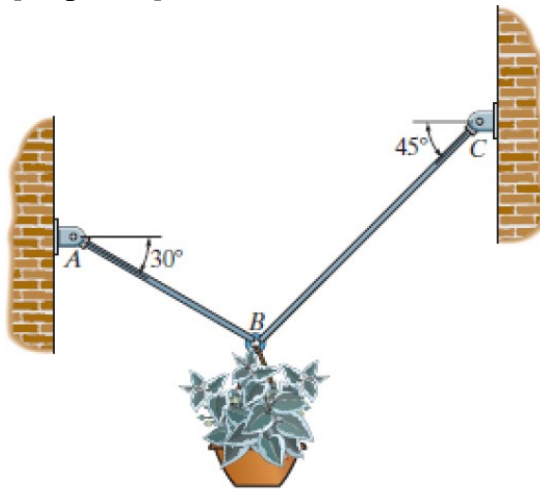
$$0.9 \times \pi \times \frac{d_{cd}^2}{4} \times 345 \times 10^6 = 9 \times 10^3$$

$$d_{cd} = 6.07 \times 10^{-3} \text{ m} = 6.07 \text{ mm}$$

$$0.9 \times \pi \times \frac{d_{AB}^2}{4} \times 345 \times 10^6 = 11.4 \times 10^3$$

$$d_{AB} = 6.83 \times 10^{-3} \text{ m} = 6.83 \text{ mm}$$

3. The 50-kg flowerpot is suspended from wires AB and BC . If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB . Use a factor of safety of 2.5. [20-points]



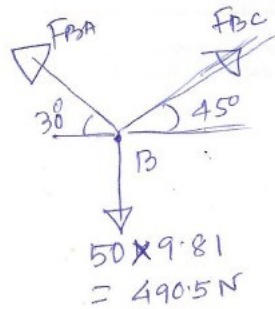
Given $\sigma = 350 \text{ MPa}$
 $\sigma_{\text{fail}} = 350 \times 10^6 \text{ N/m}^2$

F.O.S = 2.5

$$\sigma_{\text{allow}} = \frac{\sigma_{\text{fail}}}{\text{F.O.S.}}$$

$$= \frac{350 \times 10^6}{2.5}$$

$$= 140 \times 10^6 \text{ N/mm}^2$$



$$\rightarrow \sum F_x = 0$$

FBD of B

~~$F_{BC} \sin 45^\circ - F_{BA}$~~

$$F_{BC} \cos 45^\circ - F_{BA} \cos 30^\circ = 0$$

$$0.707 F_{BC} - 0.866 F_{BA} = 0 \quad \text{--- (1)}$$

$$\uparrow \sum F_y = 0$$

$$F_{BC} \sin 45^\circ + F_{BA} \sin 30^\circ - 490.5 = 0$$

$$0.707 F_{BC} + 0.5 F_{BA} = 490.5 \quad \text{--- (2)}$$

$$\textcircled{2} - \textcircled{1} \quad 1.366 F_{BA} = 490.5$$

$$F_{BA} = 359 \text{ N}$$

~~A_B A~~ $A_{BA} \times \sigma_{\text{allow}} = 359$

$$A_{BA} = \frac{359}{140 \times 10^6} = 2.56 \times 10^{-6} \text{ m}^2$$

$$\frac{\pi \times d_{AB}^2}{4} = 2.56 \times 10^{-6}$$

$$d_{AB} = 1.807 \times 10^{-3} \text{ m} = \boxed{1.807 \text{ mm}}$$

ABOVE AVERAGE

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #1 – Chapters 1-4

Given: 15 October 2021

Due: 15 October 2021 NLT 12:50pm CDT

Assignment Point Value is – 60 points

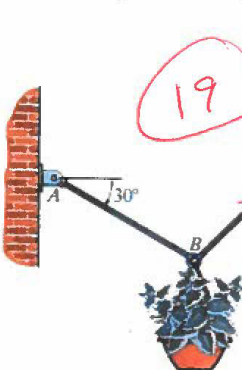
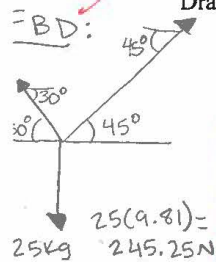
Instructions: This is a GROUP ASSIGNMENT. You will need to submit your responses below each problem. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

57
60

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. The 25-kg flowerpot is suspended from wires AB and BC. If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [20-points]



Given: 25 kg flowerpot

allowable stress $\sigma_{all} = 350 \text{ MPa}$

Find: minimum Area of wire AB

Approach:

$$F_{BC} \cos(45) - F_{BA} \cos(30) = 0$$

$$F_{BC} \sin(45) + F_{BA} \sin(30) - 245.25 \text{ N} = 0$$

$$F_{BC} (.707) - F_{BA} (.866) = 0$$

$$-(F_{BC} (.707) - F_{BA} (.5) + 245.25 \text{ N}) = 0$$

$$-F_{BA} (1.366) = -245.25 \text{ N}$$

$$-1.366 \quad -1.3661$$

$$F_{BA} = 179.539$$

$$F_{BC} =$$

$$\sigma_{allow} = \frac{P}{A}$$

$$140 \times 10^{-3} \quad 179.539$$

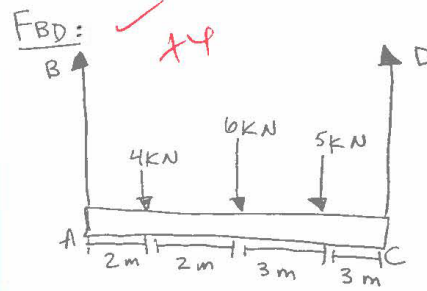
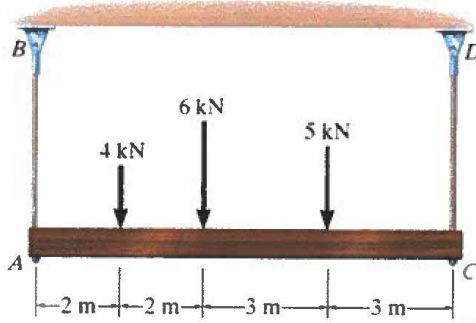
$$\frac{179.539}{140} = A$$

$$\frac{179.539}{140} = 1.282$$

$$A = 1.282 \text{ m}^2$$

beyond decimal place -

2. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{fail} = 345\text{-MPa}$. [20-points]



Given: $\phi = 0.9$

$\gamma_D = 1.2$

$\gamma_L = 1.6$

$\sigma_{fail} = 345\text{ MPa}$

Find: Smallest Diameter

$\sigma_{fail} = \frac{P}{A}$

Approach: $\sum M_A = 0$

$4\text{ kN}(2)(1.2) + 6\text{ kN}(4)(1.6) + 5\text{ kN}(7)(1.2) + F_{CD}(10) = 0$

$F_{CD} = 19\text{ kN}$

$\sum M_C = 0$

$-F_{AB}(10) + 4\text{ kN}(8)(1.2) + 6\text{ kN}(6)(1.6) + 5\text{ kN}(3)(1.2) = 0$

$F_{AB} = 11.4\text{ kN}$

$(0.9)(345(10^6)) = \frac{9(10^3)}{A}$

$d = \sqrt{\left(\frac{4}{\pi}\right) \frac{9(10^3)}{(0.9)(345)(10^6)}} = d_{CD} = 0.0060\text{ m}$

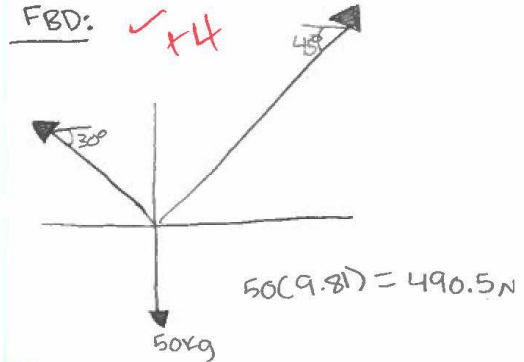
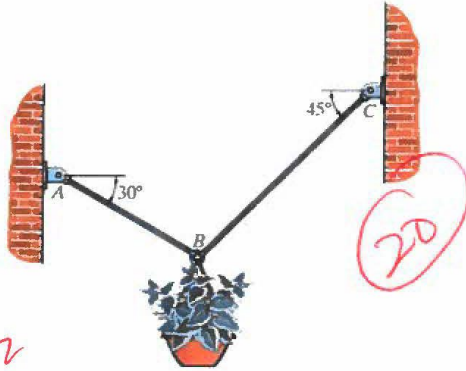
-1 beyond decimal point

$(0.9)(345(10^6)) = \frac{11.4(10^3)}{A}$

$d = \sqrt{\left(\frac{4}{\pi}\right) \frac{11.4(10^3)}{(0.9)(345)(10^6)}} = d_{AB} = 0.008\text{ m}$

-1 beyond decimal point

3. The 50-kg flowerpot is suspended from wires AB and BC . If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB . Use a factor of safety of 2.5. [20-points]



Given: 50 kg flowerpot

Failure stress = 350 MPa
Factor safety = 2.5
Find: minimum diameter

$$\sigma_{\text{allow}} = \frac{350}{2.5} = 140$$

$$\sigma_{\text{fail}} = \frac{P}{A} = \frac{\pi d^2}{4}$$

$$A(140) = \frac{359.0776}{\pi d^2}$$

$$359.0776 = \pi d^2 \cdot 140$$

$$140\pi$$

$$d = \sqrt{\frac{359.0776}{140\pi}}$$

$$d_{AB} = 1.81 \text{ mm}$$

Approach: $F_{BC} \cos(45) - F_{BA} \cos(30) = 0$

$$F_{BC} \sin(45) + F_{BA} \sin(30) - 490.5 = 0$$

$$F_{BC}(.707) - F_{BA}(.866) = 0$$

$$-1(-F_{BC}(.707) + F_{BA}(.5) + 490.5) = 0$$

$$\frac{-F_{BA}(1.366)}{-1.366} = \frac{-490.5}{-1.366}$$

$$F_{BA} = 359.0776$$

$$F_{BC}(.707) - 359.0776(.866) = 0$$

$$\frac{F_{BC}(.707)}{.707} = \frac{310.96}{.707}$$

$$F_{BC} = 439.83$$

CVEG 2101 - Materials & Dynamics Lab
(Equations Sheet)

Area of a circular section
 $A = \pi r^2$ Or $A = \pi d^2/4$

Pythagorean Theorem
 $a^2 + b^2 = c^2$

Normal Stress
 $\sigma = P/A$

Shear stress
 $\tau = V/A$

Area of section required
 $A = P/\sigma_{\text{allow}}$

Normal strain
 $\epsilon = \Delta L/L$

Modulus of Elasticity
 $E = \sigma/\epsilon$

Poisson's Ratio
$$\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_a}$$

$$G = \frac{E}{2(1 + \nu)}$$

Thermal Expansion
 $\delta = \alpha \Delta T L$

AVERAGE

NO AVERAGE STUDENT WORK SAMPLE FOR HW #1

BELOW AVERAGE

LOGWOOD, RYAN

10/15/2021

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #1 – Chapters 1-4

Given: 15 October 2021

Due: 15 October 2021 NLT 12:50pm CDT

Assignment Point Value is – 60 points

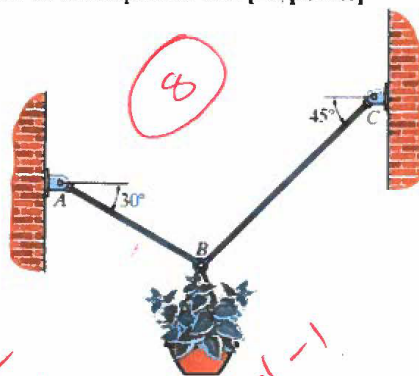
Instructions: This is a GROUP ASSIGNMENT. You will need to submit your responses below each problem. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

28
60

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. The 25-kg flowerpot is suspended from wires AB and BC . If the wires have an allowable stress of 140-MPa determine the minimum area of wire AB required to support the flowerpot. Draw all the required FBD. [20-points]



missing
FBD - 4

Approach Label - 1

GIVEN: $\sigma_{allow} = 140 \text{ MPa}$
 $m = 25 \text{ kg}$
 $\theta_A = 30^\circ, \theta_C = 45^\circ$

FIND: SMALLEST AREA OF WIRE

$$\rightarrow \sum F_x = 0; F_{BC} \cos(45^\circ) - F_{BA} \cos(30^\circ)$$

$$+\uparrow \sum F_y = 0; F_{BC} \sin(45^\circ) - F_{BA} \sin(30^\circ) - 245 \text{ N}$$

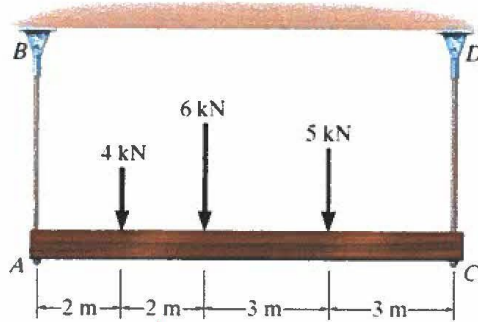
$$F_{BC} = 2239.7 \text{ N} \quad \text{math error}$$

$$F_{BA} = 1828.7 \text{ N} \quad -2 \text{ pt}$$

$$A = P / \sigma_{allow} = 1828.7 \text{ N} / (140 \text{ MPa})$$

$$13.057 \text{ mm}^2 \quad \boxed{2 = 6018.69}$$

2. The rods AB and CD are made of steel. Determine their smallest diameter so that they can support the dead loads of 4-kN, 5-kN and live load of 6-kN. The beam is assumed pin connected at A and C . Use the Load and Resistance Factor Design (LRFD) method. Assume the resistance factor for tension is $\phi = 0.9$ and the load factors for the dead and live loads are $\gamma_D = 1.2$ and $\gamma_L = 1.6$, respectively. $\sigma_{fail} = 345\text{-MPa}$. [20-points]



GIVEN: $\phi = 0.9$

$\gamma_D = 1.2$

$\gamma_L = 1.6$

$\phi_{F_{tension}} = 0.9$

FIND: SMALLEST DIAMETER

FBD:

APPROACH: DEAD+LIVE LOADS
FACTOR LOADS FOR TENSION

$F_1 = 4\text{ kN}(0.9) = 3.6\text{ kN}$ $4\text{ kN}(1.2)(1.6) = 7.68\text{ kN}$

$F_2 = 6\text{ kN}(0.9) = 5.4\text{ kN}$ $6\text{ kN}(1.2)(1.6) = 11.52\text{ kN}$

$F_3 = 5\text{ kN}(0.9) = 4.5\text{ kN}$ $5\text{ kN}(1.2)(1.6) = 9.6\text{ kN}$

$\sum M_A = 0$

$-7.68\text{ kN}(2\text{ m}) - 11.52\text{ kN}(4\text{ m}) + 9.6\text{ kN}(7\text{ m}) + F_{CD}(10\text{ m}) = 0$

$F_{CD} = 6.03\text{ kN}$ 12.864 kN

$\sum M_C = 0$

$-F_{AB}(10\text{ m}) + 7.68\text{ kN}(8\text{ m}) + 11.52\text{ kN}(6\text{ m}) + 9.6\text{ kN}(3\text{ m}) = 0$

$F_{AB} = 7.447\text{ kN}$ 15.936 kN

FACTOR FOR LIVE LOADS:

$F_{AB} = 7.447\text{ kN}(1.6) = 11.9152\text{ kN}$

$F_{CD} = 6.03\text{ kN}(1.6) = 9.648\text{ kN}$

2

CONTINUE →

~~FACTOR LOADS FOR DEAD LOADS~~

$$F_{AB} = 11.952 \text{ kN} (1.2) = 14.3424 \text{ kN}$$

$$F_{CD} = 9.648 \text{ kN} (1.2) = 11.5776$$

For ~~F_{AB}~~

$$\phi(\sigma_{\text{FAILURE}}) = \frac{P}{A}$$

$$(0.9)(345/10^6) \text{ Pa} = \frac{12.864 \text{ kN} \times 10^3}{A}$$

$$\Rightarrow A = \frac{12.864 \text{ kN} \times 10^3}{(0.9)(345 \times 10^6 \text{ Pa})} = \boxed{4.143 \times 10^{-5} \text{ m}^2}$$

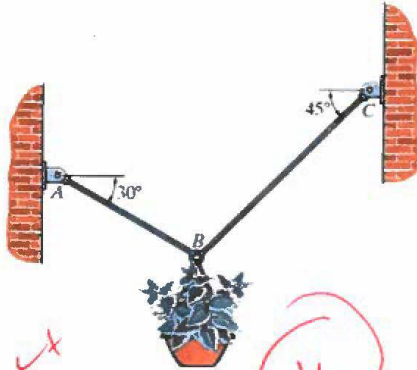
For ~~F_{CD}~~

$$\phi(\sigma_{\text{FAILURE}}) = \frac{P}{A}$$

$$(0.9)(345/10^6) \text{ Pa} = \frac{15.936 \times 10^3}{(0.9)(345 \times 10^6)} = \boxed{5.132 \times 10^{-5} \text{ m}^2}$$

$$-2.5 \times = \boxed{5.132 \times 10^{-5} \text{ m}^2}$$

3. The 50-kg flowerpot is suspended from wires AB and BC. If the wires have a normal failure stress of 350-MPa, determine the minimum diameter of the wire AB. Use a factor of safety of 2.5. [20-points]



GIVEN: $\sigma_{\text{FAIL}} = 350 \text{ MPa}$

$m = 50 \text{ kg}$

$F.S. = 2.5$

$\theta_A = 30^\circ, \theta_B = 45^\circ$

FIND: MINIMUM DIAMETER

FBD

APPROACH:

$\sum F_x = 0; F_{BC} \cos(45^\circ) - F_{BA} \cos(30^\circ) = 0$

$\sum F_y = 0; F_{BC} \sin(45^\circ) - F_{BA} \sin(30^\circ) - 490 \text{ N} = 0$

$F_{BC} = 4479.39 \rightarrow 4479.4 \text{ N}$

$F_{BA} = 3657.409 \rightarrow 3657.41 \text{ N}$

FIND ALLOWABLE STRESS

$F.S. = \frac{\sigma_{\text{FAIL}}}{\sigma_{\text{ALLOW}}} \rightarrow \sigma_{\text{ALLOW}} = \frac{\sigma_{\text{FAIL}}}{F.S.} = \frac{350 \times 10^6 \text{ Pa}}{2.5} = 140 \text{ MPa}$

FIND SMALLEST DIAMETER FOR AB

$(350(10^6)) = \frac{3657.41 \text{ N}}{\frac{\pi d^2}{4}}$

$d = \sqrt{\frac{3657.41 \text{ N} \cdot 4}{350 \times 10^6 \cdot \pi}} = 1 \text{ mm}$

- See BACK ->

$$A = \frac{P}{\sigma}$$

$$1 \cdot \frac{\pi d^2}{4} = \frac{3657.409}{140 \text{ MPa} \times 10^6} \cdot 0.4$$

$$\sqrt{\frac{\pi d^2}{4}} = \frac{1.045 \times 10^{-4}}{\pi}$$

$$X d = 0.005767 \rightarrow 0.0057$$

- 5 pts

- Block - 1
Missing

- Beyond
decimal point - 1

CVEG 2101 - Materials & Dynamics Lab
(Equations Sheet)

Area of a circular section
 $A = \pi r^2$ Or $A = \pi d^2/4$

Pythagorean Theorem
 $a^2 + b^2 = c^2$

Normal Stress
 $\sigma = P/A$

Shear stress
 $\tau = V/A$

Area of section required
 $A = P/\sigma_{\text{allow}}$

Normal strain
 $\epsilon = \Delta L/L$

Modulus of Elasticity
 $E = \sigma/\epsilon$

Poisson's Ratio
$$\nu = -\frac{\epsilon_{\text{lat}}}{\epsilon_a}$$

$$G = \frac{E}{2(1 + \nu)}$$

Thermal Expansion
 $\delta = \alpha \Delta T L$

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 2 – Homework Assignment #2 - Chapters 12

TOPICS COVERED IN HOMEWORK ASSIGNMENT 2

Homework Assignment 2 covered the following topics:

1. Rectilinear Kinematics
2. Position
3. Displacement
4. Acceleration
5. Velocity
6. Time
7. Erratic Motion
8. The s-t, v-t, a-t, v-s, a-s Graphs
9. Motion of a Projectile
10. Horizontal Motion
11. Vertical Motion

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Homework Assignment #2 – Chapter 12

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

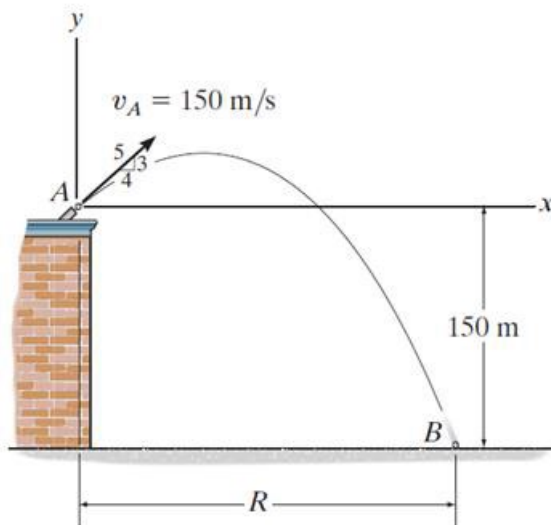
Assignment Point Value is – 60 points

Instructions: This is a **GROUP ASSIGNMENT**. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

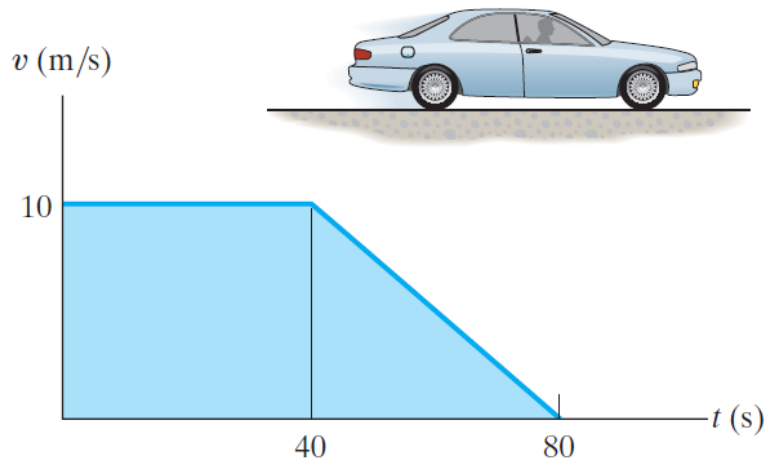
- **Given**
- **Find**
- **Draw the FBD**
- **Approach/Step-by-Step Calculations**
- **Final answer(s) will need to have a block placed around it**

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. A projectile is fired with $v_A = 150$ m/s at point A. Find the horizontal distance it travels (R) and the time in the air. Reference Example 12.11 in textbook #2. [20-points]



2. A particle travels along a straight line to the right with a velocity of $v = (4t - 3t^2)$ m/s where t is in seconds. Also, $s = 0$ when $t = 0$. Find the position and acceleration of the particle when $t = 4$ s. Reference Example 12.1 in textbook #2. **[20-points]**
3. Given the v - t graph shown. Find: The a - t graph, average speed, and distance traveled for the 0 - 80 second interval. Reference Examples 12.6, 12.7, and 12.8 in textbook #2. **[20-points]**



GRADING SCHEME FOR ASSIGNMENT

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Homework Assignment #2 – Chapter 12 - Solution

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

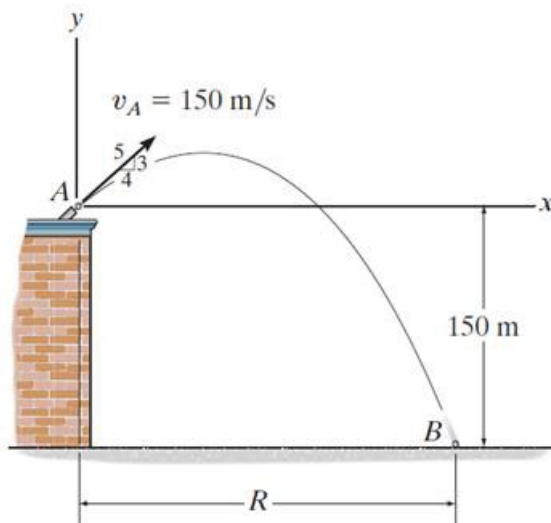
Assignment Point Value is – 60 points

Instructions: This is a **GROUP ASSIGNMENT**. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

- **Given**
- **Find**
- **Draw the FBD**
- **Approach/Step-by-Step Calculations**
- **Final answer(s) will need to have a block placed around it**

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. A projectile is fired with $v_A = 150$ m/s at point A. Find the horizontal distance it travels (R) and the time in the air. Reference Example 12.11 in textbook #2. **[20-points]**



EXAMPLE II (continued)

Solution:

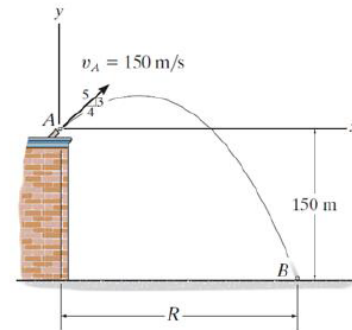
1) Place the coordinate system at point A.

Then, write the **equation for horizontal motion**.

$$+ \rightarrow x_B = x_A + v_{Ax} t_{AB}$$

where $x_B = R$, $x_A = 0$, $v_{Ax} = 150 (4/5) \text{ m/s}$

Range, R , will be $R = 120 t_{AB}$



2) Now write a **vertical motion equation**. Use the distance equation.

$$+ \uparrow y_B = y_A + v_{Ay} t_{AB} - 0.5 g t_{AB}^2$$

where $y_B = -150$, $y_A = 0$, and $v_{Ay} = 150(3/5) \text{ m/s}$

We get the following equation: $-150 = 90 t_{AB} + 0.5 (-9.81) t_{AB}^2$

Solving for t_{AB} first, $t_{AB} = \underline{19.89 \text{ s}}$.

Then, $R = 120 t_{AB} = 120 (19.89) = \underline{2387 \text{ m}}$

2. A particle travels along a straight line to the right with a velocity of $v = (4t - 3t^2)$ m/s where t is in seconds. Also, $s = 0$ when $t = 0$. Find the position and acceleration of the particle when $t = 4$ s. Reference Example 12.1 in textbook #2. **[20-points]**

EXAMPLE (continued)

Solution:

- 1) Take a derivative of the velocity to determine the **acceleration**.

$$a = dv / dt = d(4t - 3t^2) / dt = 4 - 6t$$

$$\Rightarrow a = \underline{-20 \text{ m/s}^2} \text{ (or in the } \leftarrow \text{ direction) when } t = 4 \text{ s}$$

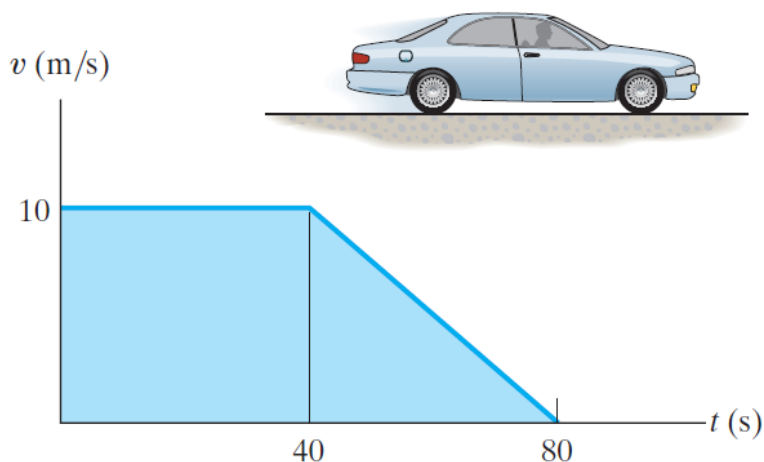
- 2) **Calculate the distance** traveled in 4s by integrating the velocity using $s_0 = 0$:

$$v = ds / dt \Rightarrow ds = v dt \Rightarrow \int_{s_0}^s ds = \int_0^t (4t - 3t^2) dt$$

$$\Rightarrow s - s_0 = 2t^2 - t^3$$

$$\Rightarrow s - 0 = 2(4)^2 - (4)^3 \Rightarrow s = \underline{-32 \text{ m}} \text{ (or } \leftarrow \text{)}$$

3. Given the **v-t** graph shown. Find: The **a-t** graph, average speed, and distance traveled for the 0 - 80 second interval. Reference Examples 12.6, 12.7, and 12.8 in textbook #2. **[20-points]**



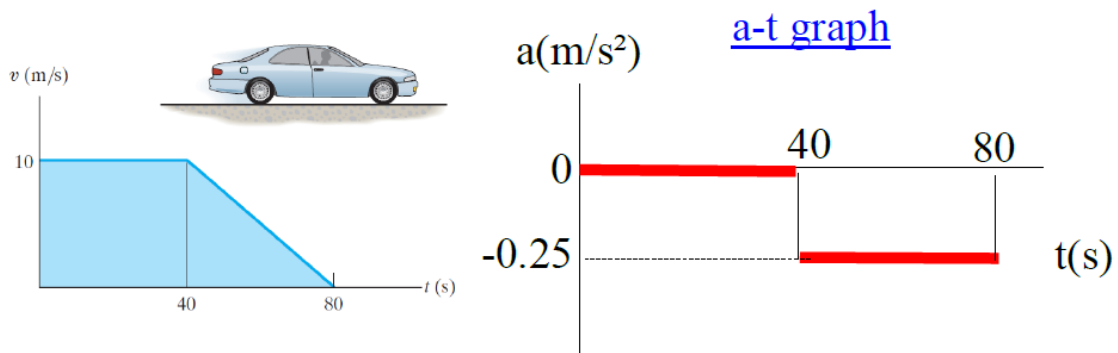
GROUP PROBLEM SOLVING I (continued)

Solution:

Find the a–t graph.

For $0 \leq t \leq 40$ $a = dv/dt = \underline{0 \text{ m/s}^2}$

For $40 \leq t \leq 80$ $a = dv/dt = -10 / 40 = \underline{-0.25 \text{ m/s}^2}$



GROUP PROBLEM SOLVING I (continued)

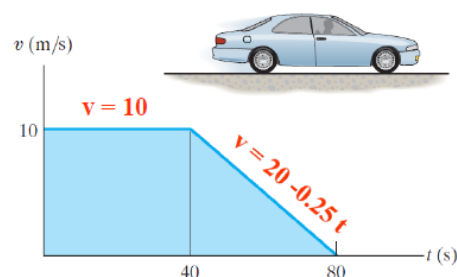
Now find the distance traveled:

$$\Delta s_{0-40} = \int v \, dt = \int 10 \, dt = 10 (40) = 400 \text{ m}$$

$$\begin{aligned} \Delta s_{40-80} &= \int v \, dt \\ &= \int (20 - 0.25 t) \, dt \\ &= \left[20 t - 0.25 (1/2) t^2 \right]_{40}^{80} = 200 \text{ m} \end{aligned}$$

$$s_{0-90} = 400 + 200 = \underline{600 \text{ m}}$$

$$\begin{aligned} v_{\text{avg}(0-90)} &= \text{total distance} / \text{time} \\ &= 600 / 80 \\ &= \underline{7.5 \text{ m/s}} \end{aligned}$$



ABOVE AVERAGE

First & Last Name Ariana Mangano

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #2 – Chapter 12

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

Assignment Point Value is – 60 points

Instructions: This is a GROUP ASSIGNMENT. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

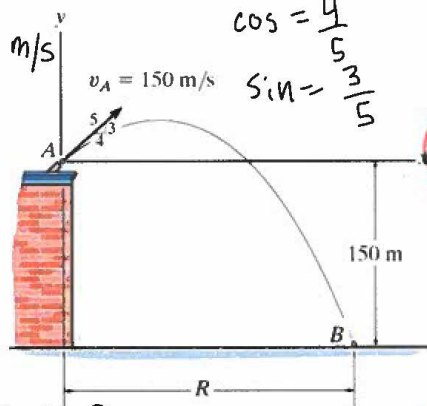
- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. A projectile is fired with $v_A = 150$ m/s at point A. Find the horizontal distance it travels (R) and the time in the air. Reference Example 12.11 in textbook #2. [20-points]

gravity =

$$2y = 9.81 \text{ m/s}^2$$



$$\cos = \frac{4}{5}$$
$$\sin = \frac{3}{5}$$

Given: $V_A = 150 \text{ m/s}$

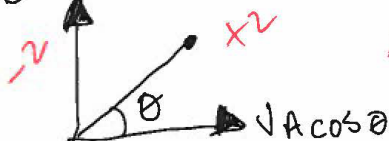
$$V_A \cos \theta = 150 \times \frac{4}{5} = 120 \text{ m/sec}$$

$$V_A \sin \theta = 150 \times \frac{3}{5} = 90 \text{ m/sec}$$

$$H_y = -150 \text{ m}$$

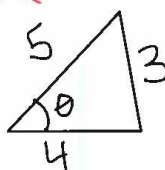
$$A_y = -9.81 \text{ m/sec}^2$$

FBD: $V_A \sin \theta$



Approach Label - 1

Find: horizontal distance (R)



time in the air - 1

1

S
O
H
C
A
H
T
O
A

$$\frac{49.5}{60}$$

$$S_y = U_y t + \frac{1}{2} A_y t^2$$

Ariana
Mangroo

$$-150 = 90t + \frac{1}{2} (-9.81)t^2$$

$$-150 = 90t + 4.905 t^2$$

$$4.905 t^2 - 90t - 150 = 0$$

$$t = 19.89 \text{ seconds}$$

$$V_x = V_A \cos \theta (t)$$

$$V_x = 120(19.89)$$

$$V_x = 2386.8 \text{ meters}$$

First & Last Name Ariana Mangroo

2. A particle travels along a straight line to the right with a velocity of $v = (4t - 3t^2)$ m/s where t is in seconds. Also, $s = 0$ when $t = 0$. Reference Example 12.1 in textbook #2. [20-points]

Given:

- $v = (4t - 3t^2)$
- $s = 0$
- $t = 0$

Find:

Position and
acceleration
of particle
at $t = 4$ sec.

Approach:

$$v = 4t - 3t^2$$

#130 last -1

$$v = \frac{ds}{dt} = (4t - 3t^2)$$

$$\Rightarrow \int_0^0 ds = \int_0^0 (4t - 3t^2) dt$$

$$\Rightarrow s \Big|_0^0 = 2t^2 - t^3 \Big|_0^0$$

$$s = 2t^2 - t^3$$

$a = ?$ -5

$$t = 4 \text{ seconds}$$

$$s = 2(4)^2 - (4)^3$$

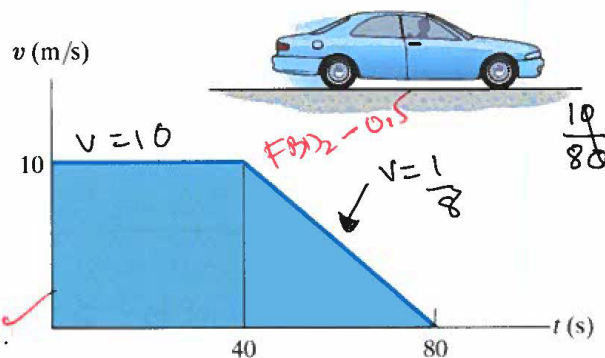
$$s = 2(16) - 64$$

$$s = 32 - 64$$

$$s = -32 \text{ m}$$

First & Last Name Ariana Mangroo

3. Given the v-t graph shown. Find: The a-t graph, average speed, and distance traveled for the 0 - 80 second interval. Reference Examples 12.6, 12.7, and 12.8 in textbook #2. [20-points]



Given: ✓
v-t graph

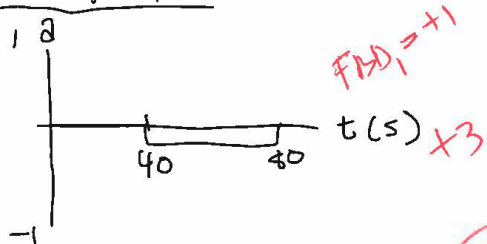
Find: ✓
• a-t graph
• Speed avg
• distance traveled

Approach:

$$0 \leq t < 40s; \quad v = 10 \text{ m/s} \quad ; \quad a = \frac{dv}{dt} = 0$$

$$40 \leq t \leq 80; \quad v = -\frac{1}{8} \text{ m/s} \quad ; \quad a = \frac{dv}{dt} = -\frac{1}{8}$$

a-t graph



Distance Traveled:

$$A = bh + \frac{1}{2}bh$$

$$A = 40(10) + \frac{1}{2}(40)(10)$$

$$A = 400 + 200$$

$$\boxed{A = 600 \text{ m}} \quad +3$$

Average Speed:

$$\text{Avg speed} = \frac{\text{distance Traveled}}{\text{time}}$$

$$= \frac{600}{80} = \boxed{\frac{15}{2} \text{ or } 7.5 \text{ m/s}} \quad +3$$

AVERAGE

NO AVERAGE STUDENT WORK SAMPLE FOR HW #2

BELOW AVERAGE

First & Last Name

Log wave1

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #2 – Chapter 12

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

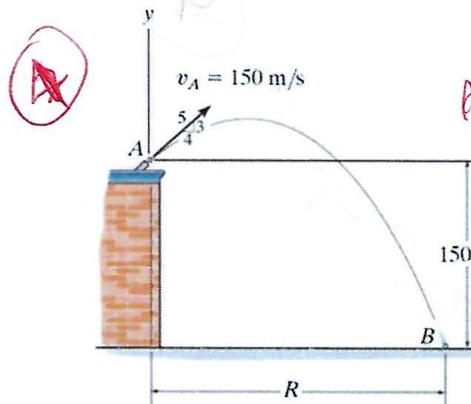
Assignment Point Value is – 60 points

Instructions: This is a GROUP ASSIGNMENT. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

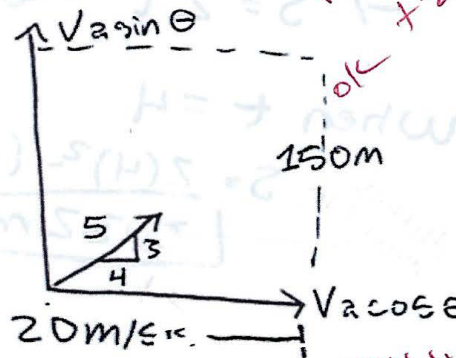
- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. A projectile is fired with $v_A = 150$ m/s at point A. Find the horizontal distance it travels (R) and the time in the air. Reference Example 12.11 in textbook #2. [20-points]



Approach Label - 1
FBD Label - 1



$$v \cos \theta = 150 \times \frac{4}{5} = 120 \text{ m/s}$$

$$v \sin \theta = 150 \text{ m/s} \times \frac{3}{5} = 90 \text{ m/s}$$

$$H_y = 150 \text{ m}$$

$$a_y = -9.81 \text{ m/s}^2$$

answer missing

2. A particle travels along a straight line to the right with a velocity of $v = (4t - 3t^2)$ m/s where t is in seconds. Also, $s = 0$ when $t = 0$. Reference Example 12.1 in textbook #2. **[20-points]**

GIVEN: $V = (4t - 3t^2)$,
 $t = 0, S = 0$

ANALYSIS: $v = \frac{ds}{dt} = (4t - 3t^2)$
 $= \int_0^2 (4t - 3t^2) dt$

$$\Rightarrow S = 2t^2 - t^3$$

when $t = 4$

When $t = 4$

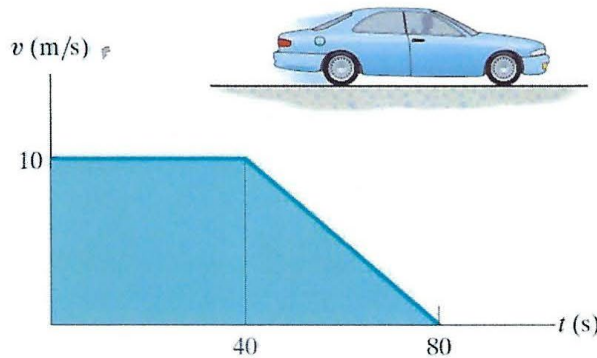
$$S = \frac{2(4)^2 - (4)^3}{2}$$

MISSING MINUS SIGN

$\boxed{32\text{m}}$

First & Last Name _____

3. Given the $v-t$ graph shown. Find: The $a-t$ graph, average speed, and distance traveled for the 0 - 80 second interval. Reference Examples 12.6, 12.7, and 12.8 in textbook #2. [20-points]



(10)

GIVEN:

$$0 \leq t < 40 \text{ s}; v = 10 \frac{\text{m}}{\text{s}}; a = \frac{dv}{dt} = 0$$

$$40 \leq t \leq 80; a = \frac{dv}{dt} = -1/8$$

$$v = -\frac{1}{8}t + \frac{m}{s}$$

FIND: S_{avg} , distance (x)

ANALYSIS: ok

$$S_{\text{avg}} = \frac{d \cdot t}{2} \Rightarrow \boxed{\frac{15}{2} \text{ m/s}} ?$$

-0.33 FBD -2

X Distance

$$A = bh + \frac{1}{2}bh$$

MISSING 9 + graph -3

$$= (40)(10) + \frac{1}{2}(40\text{m})(10\text{m})$$

$$= \boxed{600\text{m}}$$

**MATERIALS & DYNAMICS LAB
FALL 2021**

ASSIGNMENT 3 – Homework Assignment #3 - Chapters 13 & 14

TOPICS COVERED IN HOMEWORK ASSIGNMENT 3

Homework Assignment 3 covered the following topics:

1. Newton's Second Law of Motion
2. Equation of Motion
3. Determine Central Force Motion
4. Principle of Work and Energy
5. Work of Friction Caused by Sliding

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #3 – Chapters 13 and 14

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

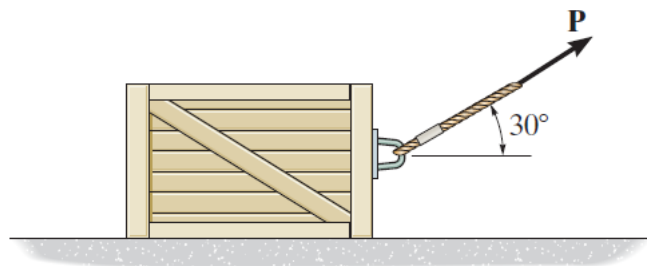
Assignment Point Value is – 60 points

Instructions: This is a **GROUP ASSIGNMENT**. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

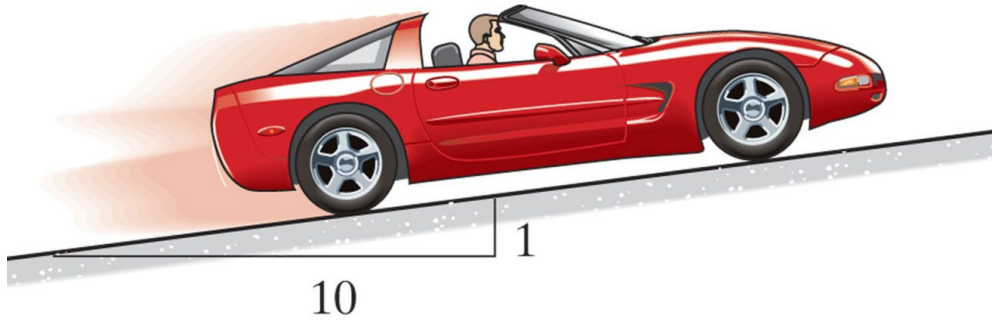
- **Given**
- **Find**
- **Draw the FBD**
- **Approach/Step-by-Step Calculations**
- **Final answer(s)** will need to have a block placed around it

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$ determine the distance the crate travels and its velocity when $t = 3$ seconds. The crate starts from rest, and $P = 200$ N. Reference Example 13.1 in textbook #2. **[20-points]**



2. A 2000-kg sports car increases its speed uniformly from rest to 25 m/s in 30 seconds. The engine efficiency $\mathcal{E} = 0.8$. Determine the maximum power and the average power supplied by the engine. Reference Example 14.2 in textbook #2. **[40-points]**



GRADING SCHEME FOR ASSIGNMENT

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab

Fall 2021

Homework Assignment #3 – Chapters 13 and 14 - Solution

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

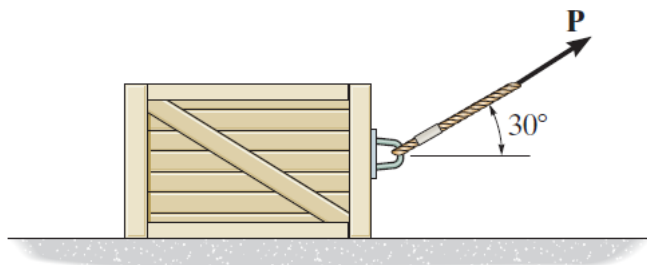
Assignment Point Value is – 60 points

Instructions: This is a **GROUP ASSIGNMENT**. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

- **Given**
- **Find**
- **Draw the FBD**
- **Approach/Step-by-Step Calculations**
- **Final answer(s)** will need to have a block placed around it

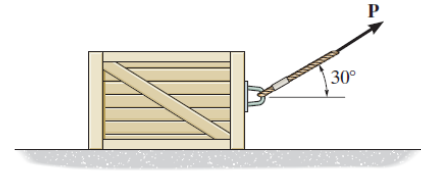
Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$ determine the distance the crate travels and its velocity when $t = 3$ seconds. The crate starts from rest, and $P = 200$ N. Reference Example 13.1 in textbook #2. **[20-points]**



13-3.

If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$, determine the distance the crate travels and its velocity when $t = 3$ s. The crate starts from rest, and $P = 200$ N.



SOLUTION

Free-Body Diagram: The kinetic friction $F_f = \mu_k N$ is directed to the left to oppose the motion of the crate which is to the right, Fig. *a*.

Equations of Motion: Here, $a_y = 0$. Thus,

$$+\uparrow \Sigma F_y = 0; \quad N - 50(9.81) + 200 \sin 30^\circ = 0$$

$$N = 390.5 \text{ N}$$

$$\rightarrow \Sigma F_x = ma_x; \quad 200 \cos 30^\circ - 0.3(390.5) = 50a$$

$$a = 1.121 \text{ m/s}^2$$

Kinematics: Since the acceleration **a** of the crate is constant,

$$(\rightarrow) \quad v = v_0 + a_c t$$

$$v = 0 + 1.121(3) = 3.36 \text{ m/s}$$

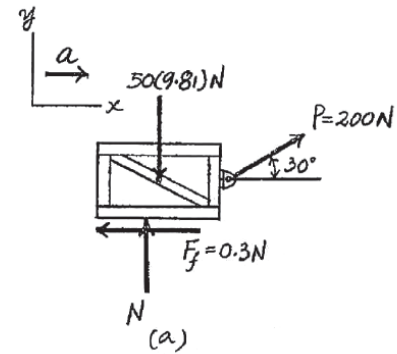
Ans.

and

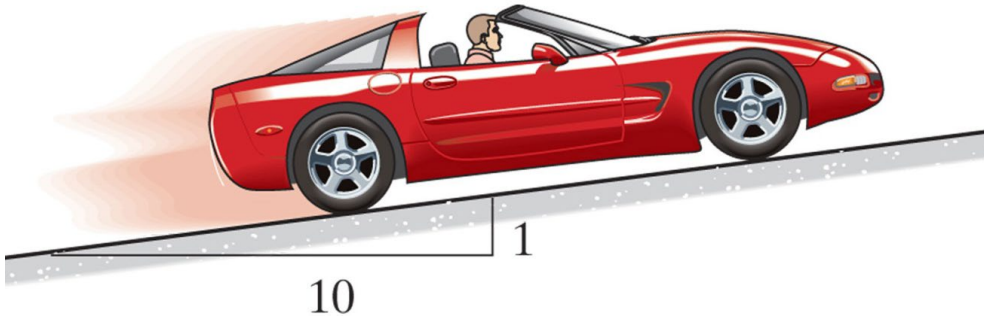
$$(\rightarrow) \quad s = s_0 + v_0 t + \frac{1}{2} a_c t^2$$

$$s = 0 + 0 + \frac{1}{2}(1.121)(3^2) = 5.04 \text{ m}$$

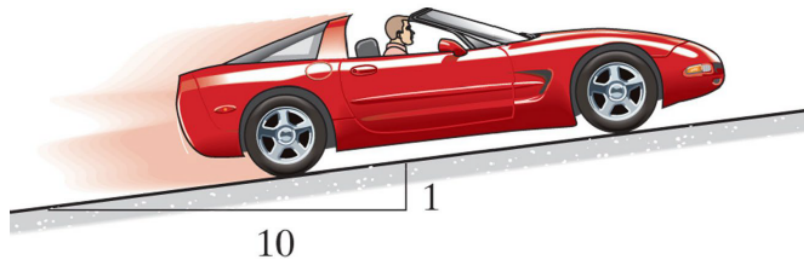
Ans.



2. A 2000-kg sports car increases its speed uniformly from rest to 25 m/s in 30 seconds. The engine efficiency $\mathcal{E} = 0.8$. Determine the maximum power and the average power supplied by the engine. Reference Example 14.2 in textbook #2. [40-points]



GROUP PROBLEM SOLVING



Given: A 2000 kg sports car increases its speed uniformly from rest to 25 m/s in 30 s. The engine efficiency $\mathcal{E} = 0.8$.

Find: The maximum power and the average power supplied by the engine.

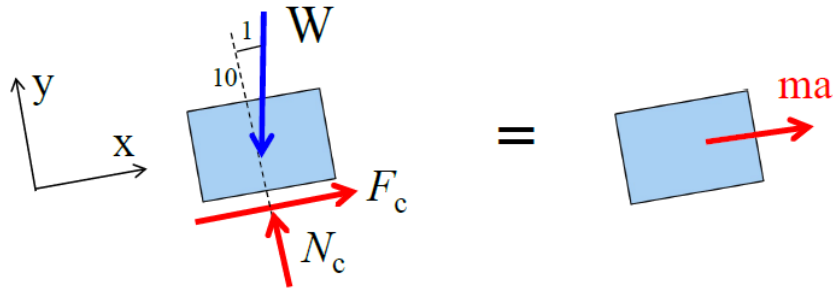
Plan:

- 1) Draw the car's free body and kinetic diagrams.
- 2) Apply the equation of motion and kinematic equations to find the force.
- 3) Determine the output power required.
- 4) Use the engine's efficiency to determine input power.

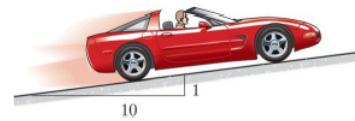
GROUP PROBLEM SOLVING (continued)

Solution:

- 1) Draw the FBD & Kinetic Diagram of the car as a particle.



The normal force N_c and frictional force F_c represent the resultant forces of all four wheels.



The frictional force between the wheels and road pushes the car forward. What are we neglecting with this approach?

GROUP PROBLEM SOLVING (continued)

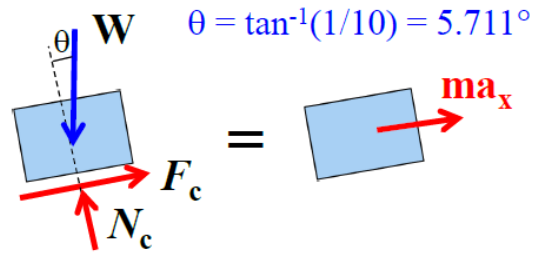
2) The equation of motion

$$+ \rightarrow \Sigma F_x = ma_x \Rightarrow -2000 \text{ g} (\sin 5.711^\circ) + F_c = 2000 a_x$$

Determine a_x using constant acceleration equation

$$\Rightarrow v = v_0 + a_x t$$

$$a_x = (25 - 0) / 30 = 8.333 \text{ m/s}^2$$



Substitute a_x into the equation of motion and determine frictional force F_c :

$$\begin{aligned} F_c &= 2000 a_x + 2000 \text{ g} (\sin 5.711^\circ) \\ &= 2000(8.333) + 2000 (9.81) (\sin 5.711) = 3619 \text{ N} \end{aligned}$$

ABOVE AVERAGE

First & Last Name Omar Hejo

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #3 – Chapters 13 and 14

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

Assignment Point Value is – 60 points

Instructions: This is a GROUP ASSIGNMENT. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

Problem 1

- Given: 50 kg crate, friction is 0.3 Nc, $t = 3$ s, $P = 200$ N
- Find: Find distance and velocity at 3 seconds
- Draw the FBD.
- Approach/Step-by-Step Calculations:
- Final answer(s) will need to have a block placed around it:

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

- If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$ determine the distance the crate travels and its velocity when $t = 3$ seconds. The crate starts from rest, and $P = 200$ N. Reference Example 13.1 in textbook #2. [20-points]

490.5 N

200 N

30°

$\Sigma F_x = m a_x = 200 \cos 30 - 0.3 N_c = 50 a$

$\Sigma F_y = N_c - 490.5 + 200 \sin 30 = 0$

$N_c = 390.4$

$577.35 - 166.6 a = 390.4$

$a = 1.1215 \text{ m/s}^2$

$v = v_0 + a t = 0 + 1.1215(3)$

$v = 3.3645 \text{ m/s}$

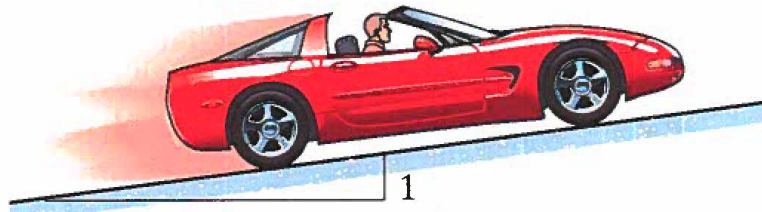
Distance = $s = s_0 + v_0 t + \frac{1}{2} a t^2 = s = 0 + 0 + \frac{1}{2} (1.1215)(3)^2 = 5.05 \text{ m}$

Approach Label

beyond the decimal

First & Last Name Omer Hwjo

2. A 2000-kg sports car increases its speed uniformly from rest to 25 m/s in 30 seconds. The engine efficiency $\epsilon = 0.8$. Determine the maximum power and the average power supplied by the engine. Reference Example 14.2 in textbook #2. [40-points]



- Given: 2000 kg car, $V_0 = 0$, $V = 25$, $t = 30$, $\epsilon = .8$
- Find: Max power and average power
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

$$V = V_0 + at$$

$$25 = 0 + a(30)$$

$$\frac{25}{30} = a$$

$$a = .8333 \text{ m/s}^2$$

$$\tan \theta = \frac{1}{10}$$

$$\tan^{-1}\left(\frac{1}{10}\right) = \theta$$

$$\theta = 5.71^\circ$$

$$F = 2000(9.8) \sin(5.71) + 2000(.8333)$$

$$F = 3616.67 \text{ N}$$

$$P = F \cdot v$$

$$P = (3616.67 \text{ N})(25)$$

$$\frac{P}{\epsilon} = \frac{90416.75}{.8} \times \frac{1}{1000} = \boxed{113.02 \text{ kW}} \quad \text{Max}$$

$$P_{\text{average}} = F \cdot v_{\text{avg}} = (3616.67) \left(\frac{25}{2} \right) = 45208.375$$

$$\frac{P_{\text{avg}}}{\epsilon} = \frac{45208.375}{.8} \times \frac{1}{1000} = \boxed{56.51 \text{ kW}} \quad \text{average}$$

Sohcah tan

OPP
adj

$$2000(9.8) = 19600 \text{ N}$$



38

AVERAGE

NO AVERAGE STUDENT WORK SAMPLE FOR HW #3

BELOW AVERAGE

First & Last Name

RYAN LOGWOOD

Prairie View A&M University
College of Engineering
Civil & Environmental Engineering Department

CVEG 2101 – Materials and Dynamics Lab
Fall 2021

Homework Assignment #3 – Chapters 13 and 14

Given: 12 November 2021

Due: 12 November 2021 NLT 12:50pm CST

Assignment Point Value is – 60 points

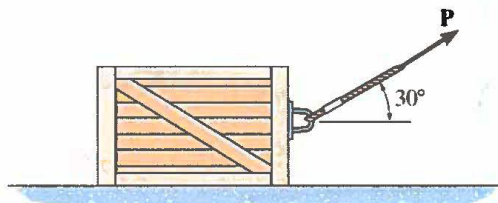
Instructions: This is a GROUP ASSIGNMENT. You will need to submit your responses below each problem or on separate engineering paper. The format to use to submit your response to the each problem is below. These sub-headings must be part of your response to each problem. No exceptions.

- Given
- Find
- Draw the FBD
- Approach/Step-by-Step Calculations
- Final answer(s) will need to have a block placed around it

45
60

Your numerical answer should not go beyond two places after the decimal point. More points will count toward the process used to compute your final answer. You must work in teams for this assignment.

1. If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$ determine the distance the crate travels and its velocity when $t = 3$ seconds. The crate starts from rest, and $P = 200$ N. Reference Example 13.1 in textbook #2. [20-points]



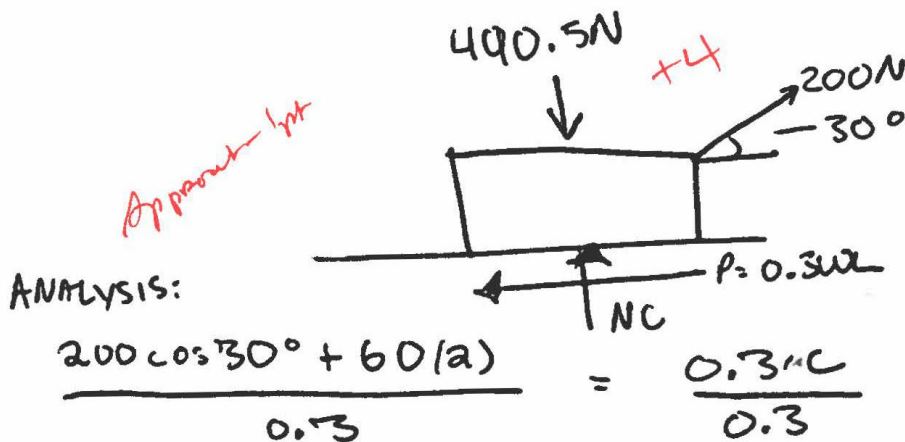
14

G - 2pts
F - 2pts
FBD ✓

$$m = 50 \text{ kg}, \mu = 0.3 \text{ NC}$$

$$P = 200 \text{ N}, t = 3 \text{ s}$$

FIND: d & v



$$\times 7 \quad N_C = 577.35 - 166.66 a$$

$$\sum F_x = m a_x \Rightarrow 200 \text{ N} \cos(30^\circ) - 0.3 N_C = 50 a$$

$$\sum F_y = N_C - 490.5 \text{ N} + 200 \text{ N} \sin 30^\circ = 0$$

$$(577.35 - 166.66 a) - 490.5 \text{ N} + 200 \text{ N} \sin(30^\circ) = 0$$

$$a = 1.125 \text{ m/s}^2$$

$$v = v_0 + a t = 0 + 1.125 \text{ m/s} = \boxed{1.125 \text{ m/s}}$$

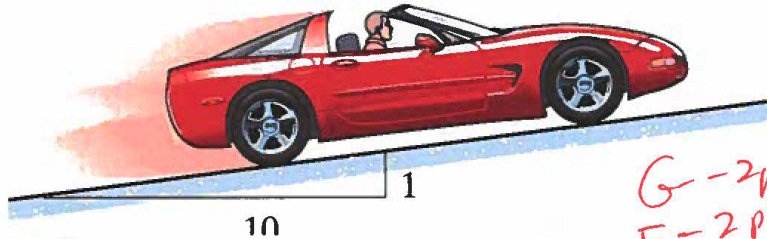
beyond deceleration ✓ $+2.5$

$$x = s \Rightarrow s_0 + v_0 t + \frac{1}{2} a t^2 = \boxed{5.05 \text{ m}}$$

✓ $+2.5$

First & Last Name _____

2. A 2000-kg sports car increases its speed uniformly from rest to 25 m/s in 30 seconds. The engine efficiency $\epsilon = 0.8$. Determine the maximum power and the average power supplied by the engine. Reference Example 14.2 in textbook #2. [40-points]



$$v = v_0 + at$$

$$25 \text{ m/s} = 0 \text{ m/s} + a(30 \text{ sec})$$

$$\Rightarrow a = \frac{25 \text{ m/s}}{30 \text{ s}} = \underline{0.8\bar{3} \text{ m/sec}^2}$$

$$\tan^{-1} \left(\frac{1 \text{ m}}{10 \text{ m}} \right) = \theta = 5.71059 \rightarrow \underline{5.711^\circ}$$

$$F = 2000 \text{ kg} (9.8 \text{ m/s}^2) \sin(5.711^\circ) + 2000 \text{ kg} (0.8\bar{3} \text{ m/s}^2) \\ = \underline{13616 \frac{2}{3} \text{ N}}$$

$$P = F \times v \rightarrow (13616.67 \text{ N})(25 \text{ m/s}) = \frac{90416.75}{0.8} \\ = \underline{113020 \text{ W or } 113.02 \text{ kW}}$$

$$P_{\text{avg}} = \frac{F \times v_{\text{avg}}}{\epsilon} = \frac{13616 \frac{2}{3} \text{ N} \cdot \frac{25 \text{ m/s}}{2}}{0.8} = \underline{56,510 \text{ W}} \\ \underline{\text{or } 56.510 \text{ kW}}$$

G - 2 pts
F - 2 pts
FBD - 3 pts
Approach Label - 2

37

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 1 – Laboratory Assignment #1 - Stress & Strain

TOPICS COVERED IN LABORATORY ASSIGNMENT 1

Laboratory Assignment I covered the following topics:

1. Stress-Strain Curve
2. Modulus of Elasticity
3. Yield Stress
4. Ultimate Stress
5. Fracture Stress

ASSIGNMENT STATEMENT/QUESTIONS

**Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 1 – Stress & Strain
Given: September 3, 2021
Due September 10, 2021 no later than 11:00 PM**

Instructions: Report Due Date: September 10, 2021 before 11: 00 PM. Students will need to create a file as shown below.

file: Last name (space) First name (space) Stress & Strain CVEG 2101

Upload to: CVEG 2101-P81 CANVAS portal under Assignment: Lab Report # 1 - Stress & Strain

A full set of data from a tensile test on 1018 steel stock sample are provided. The dimension of the sample tested is given in the following section. The test results are given in the next page.

Sample Dimension:

Diameter of the steel: 0.41 mm

Length of the sample steel: 95
mm

Prepare a report showing the mechanical properties of the material tested. The report should contain;

1. Detail sketch of the Stress-Strain curve
2. Detail sketch in the graph to find modulus of elasticity, yield stress, ultimate stress and fracture stress of the material tested
3. Different curve should be provided in the report showing different property of the material
4. Sample calculation
5. A professional report must be submitted (table of contents, abstract, introduction of stress-strain theory, test procedure, detail results, discussion of the test results, appendices etc. should be included in the report)

NOTE: QUALITY OF YOUR WORK AND PRESENTATION WILL BE TAKEN INTO ACCOUNT FOR GRADING OF THIS REPORT

Force	Displacement	Force	Displacement
(N)	(mm)	(N)	(mm)
0	0	9079	3.773
81	0.063	9229	4.173
142	0.113	9379	4.573
201	0.173	9479	4.973
263	0.233	9579	5.373
708	0.273	9679	5.773
1192	0.303	9729	6.173
1455	0.343	9779	6.573
2000	0.383	9879	6.973
2243	0.423	9879	7.373
2686	0.463	9779	7.773
3050	0.503	9779	8.173
3454	0.533	9779	8.573
3979	0.573	9779	8.973
4282	0.613	9779	9.373
4726	0.653	9779	9.773
5049	0.693	9779	10.173
5372	0.723	9729	10.573
5978	0.763	9679	10.973
6301	0.803	9629	11.373
6679	0.973	9579	11.773
7079	1.373	9479	12.173
7679	1.773	9279	12.573
7979	2.173	8879	12.973
8279	2.573	9579	13.373
8729	2.973	7379	13.773
8929	3.373		

GRADING SCHEME FOR ASSIGNMENT

**Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab**

Lab Assignment – 1 – Stress & Strain

Given: September 3, 2021

Due September 10, 2021 no later than 11:00 PM

1. Your lab report should have the following on the cover page
 - a. Your name and roster number
 - b. Course prefix, number, section, and title
 - c. Homework number
 - d. Date given
 - e. Date due
2. Lab report template
 - a. Table of Content
 - b. Abstract
 - c. Introduction
 - d. Theory
 - e. Test Procedure
 - f. Detail Results
 - g. Discussion of Test Results
 - h. Appendices
 - i. References
3. Show all Steps for arriving the final answers
4. Reference all figures, tables, constant values, equation and conversion
5. Show units

Graded by Dr. Alam

Student 1 - Incomplete graph (missing units), missing calculation - (Grade 75)

Student 2 - Incomplete graph (missing units and title) - (Grade 92)

Student 3 – Missing abstract, missing introduction, missing calculation, missing appendices - (Grade 75)

Student 4 – Incomplete graph (missing titles on axis), missing calculation - (Grade 75)

Student 5 – Missing graph, missing results, missing discussion, missing calculation – (Grade 60)

ABOVE AVERAGE



92

Omar Hajo
Mechanics of Materials 2332
Dr. Jobair
Lab Report 1: Stress Strain Theory
09/23/2021

TABLE OF CONTENTS

INTRODUCTION	PAGE 3
ABSTRACT	PAGE 3
THEORY	PAGE 4-5
TEST RESULTS	PAGE 6-8
TEST RESULTS EXPLANATION	PAGE 9-10
APPENDIX	PAGE 11-12
CONCLUSION	PAGE 13
RESOURCES	PAGE 14

Abstract

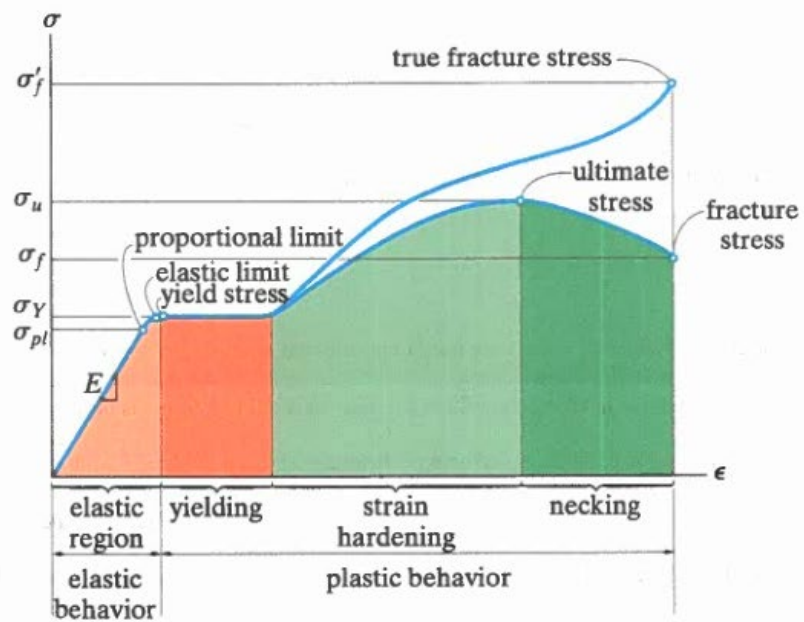
The purpose of this lab was to find stress and strain from the given data points. With this information I was able to create a clear and concise graph which allows us to extract the modulus of elasticity, yield stress, ultimate stress, and fracture stress.

Introduction

Stress strain theory / curves are used to portray the relationship between a material's stress and strain. As defended in an article written by Andreas Velling, "Stress is defined as a ratio of the applied force to the cross sectional area of the material its applied to."¹ Andreas also referred to strain by stating, "Strain is defined as the ratio of the change in dimension to the initial dimension of the metal."¹ The main purpose of this lab is to obtain a greater understanding between the relationship of stress and strain. David Redmond mentioned on a site titled as *Stress Strain Curve: Definition & Yield Point*, that a "Stress strain curve is a graphical representation of the behavior of a material when it's subjected to a load or force."² Once a clear and concise graph is obtained modulus of elasticity, yield stress, ultimate stress and fractured stress will become visible.

Theory

Diagram representation of lab requirements figure 1



(Mechanic's of Materials Textbook) /

Area figure 2

$$\frac{\pi}{4}d^2$$

— write the equation
not copy and paste

(Mechanic's of Materials Textbook)

Stress figure 3

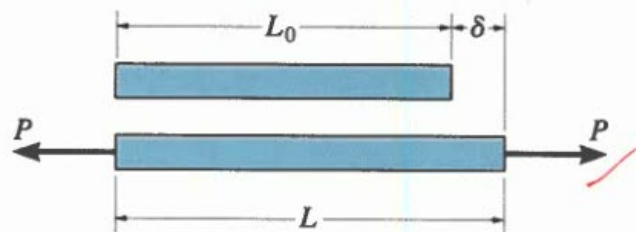
$$N = \sigma A$$

$$\sigma = \frac{N}{A}$$

(Mechanic's of Materials Textbook)

Displacement figure 4

$$\delta \text{ (delta)} = L - L_0$$



(Mechanic's of Materials Textbook)

Strain figure 5

$$\epsilon_{\text{avg}} = \frac{L - L_0}{L_0}$$

(Mechanic's of Materials from textbook)

Test results

Figure 6

Force (N)	Displacement (mm)	Stress (N/mm ²)	Strain	% offset 0.002	% offset 0.005
0	0	0	0	0	0
81	0.063	633.0769231	0.00063	0.002	0
142	0.113	1092.307692	0.00113	0.0025	4000
201	0.173	1546.153846	0.00173	0.003	8000
263	0.233	2023.076923	0.00233	0.0035	12000
708	0.273	5446.153846	0.00273	0.004	16000
1192	0.303	9169.230769	0.00303	0.0045	20000
1455	0.343	11192.30769	0.00343	0.005	24000
2000	0.383	15384.61538	0.00383	0.0055	28000
2243	0.423	17253.84615	0.00423	0.006	32000
2686	0.463	20661.53846	0.00463	0.0065	36000
3050	0.503	23461.53846	0.00503	0.007	40000
3454	0.533	26569.23077	0.00533	0.0075	44000
3979	0.573	30607.69231	0.00573	0.008	48000
4282	0.613	32938.46154	0.00613	0.0085	52000
4726	0.653	36353.84615	0.00653	0.009	56000
5049	0.693	38838.46154	0.00693	0.0095	60000
5372	0.723	41323.07692	0.00723	0.01	64000
5978	0.763	45984.61538	0.00763	0.0105	68000
6301	0.803	48469.23077	0.00803	0.011	72000
6679	0.973	51376.92308	0.00973	0.0115	76000
7079	1.373	54453.84615	0.01373	0.012	80000
7679	1.773	59069.23077	0.01773	0.0125	84000
7979	2.173	61376.92308	0.02173	0.013	88000
8279	2.573	63684.61538	0.02573	0.0135	92000
8729	2.973	67146.15385	0.02973	0.014	96000
8929	3.373	68684.61538	0.03373	0.0145	100000
9079	3.773	69838.46154	0.03773	0.015	104000
9229	4.173	70992.30769	0.04173	0.0155	108000
9379	4.573	72146.15385	0.04573	0.016	112000
9479	4.973	72915.38462	0.04973	0.0165	116000
9579	5.373	73684.61538	0.05373	0.017	120000
9679	5.773	74453.84615	0.05773	0.0175	124000
9729	6.173	74838.46154	0.06173	0.018	128000
9779	6.573	75223.07692	0.06573	0.0185	132000
9879	6.973	75992.30769	0.06973	0.019	136000
9879	7.373	75992.30769	0.07373	0.0195	140000
9779	7.773	75223.07692	0.07773	0.02	144000
9779	8.173	75223.07692	0.08173	0.0205	148000
9779	8.573	75223.07692	0.08573	0.021	152000
9779	8.973	75223.07692	0.08973	0.0215	156000
9779	9.373	75223.07692	0.09373	0.022	160000
9779	9.773	75223.07692	0.09773	0.0225	164000
9779	10.173	75223.07692	0.10173	0.023	168000
9729	10.573	74838.46154	0.10573	0.0235	172000
9679	10.973	74453.84615	0.10973	0.024	176000
9629	11.373	74069.23077	0.11373	0.0245	180000
9579	11.773	73684.61538	0.11773	0.025	184000
9479	12.173	72915.38462	0.12173	0.0255	188000
9279	12.573	71376.92308	0.12573	0.026	192000
8879	12.973	68300	0.12973	0.0265	196000
9579	13.373	73684.61538	0.13373	0.027	200000
7379	13.773	56761.53846	0.13773	0.0275	204000

02

Figure 7

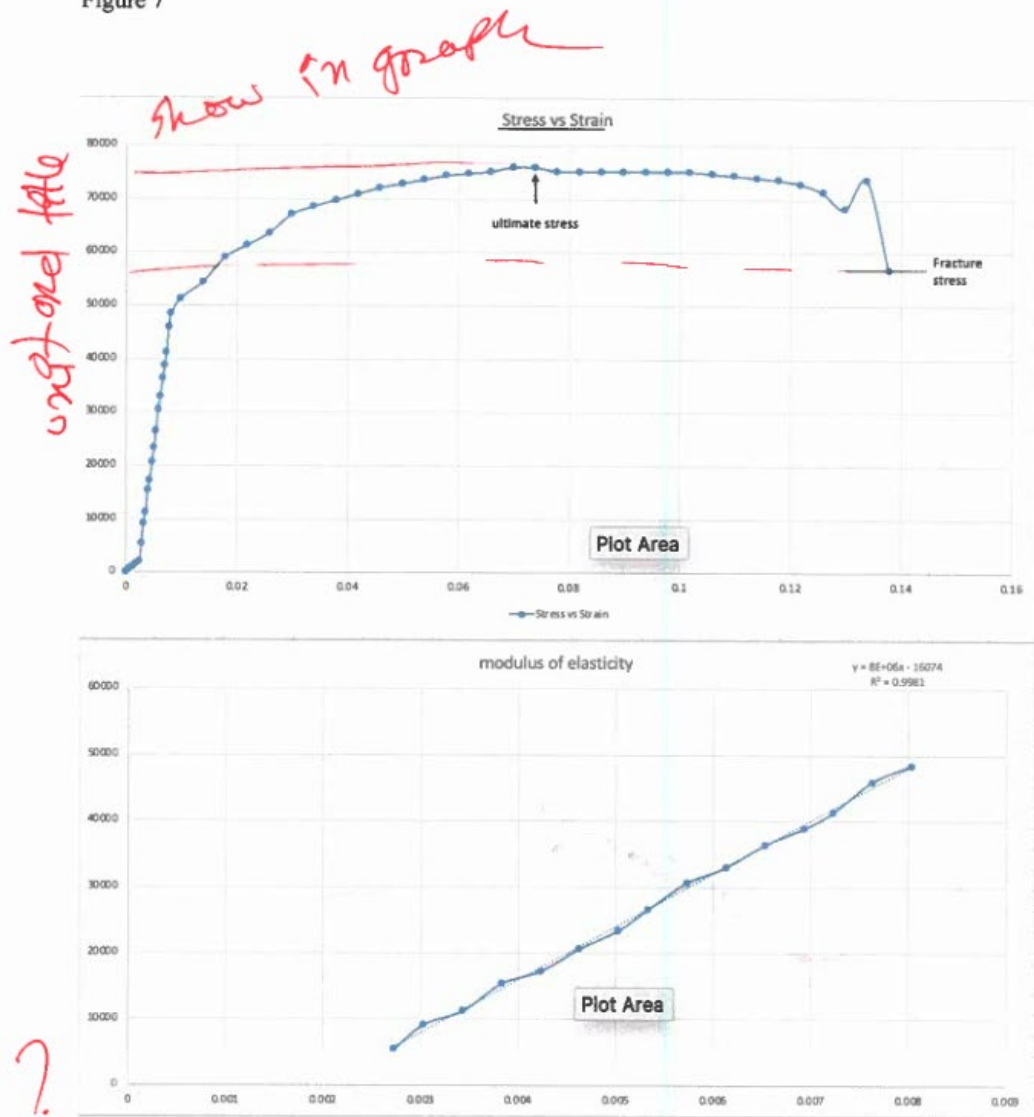
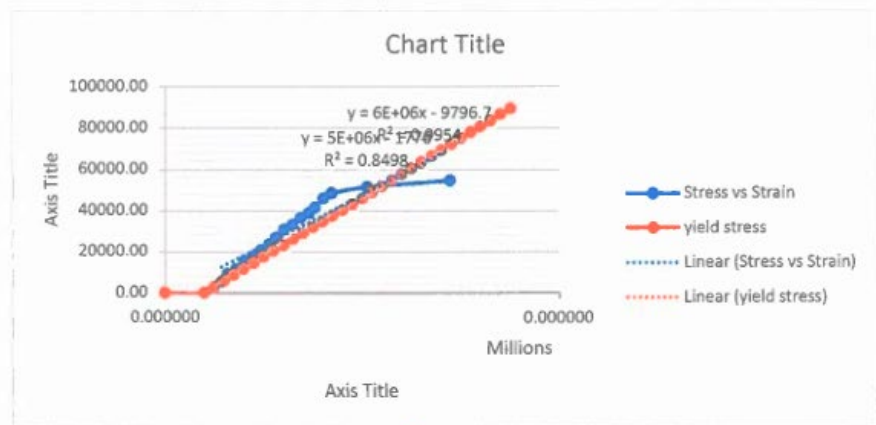
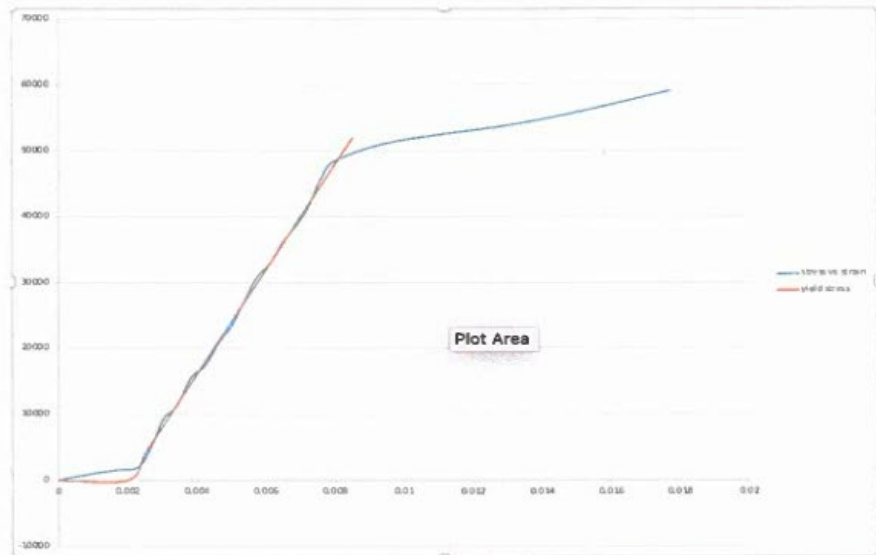


Figure 8



2

Test results explanation

The process of completing this lab begins with calculating specific calculations given the data provided. Given force and displacement you can find stress and strain once all necessary values are obtained.

The starting point is by using the area equation given in figure 2. The purpose of calculating the area first is so that from there you can calculate the stress in figure 3. Given the equation stress is attained for roughly 100 data points. In figure 6 it shows the stress results. In the lab procedures the stress strain graph is required in order to begin plotting. Strain is the following calculation needed and to get that, figure 5 is used. The displacement is subtracted by the length given by the professor (95mm) which is known as the initial and once subtracted, divide by the initial value.

Stress and Strain is now calculated, and the graph can be attained using a Stress vs Strain graph. The modulus of elasticity can be attained from the graph using an excel function to find the trendline and the equation of the graph. Modulus of elasticity in this case is $8E+06$. Which means after this point it becomes in a state of plasticity. This value is in figure 7 as the second graph.

Just as modulus of elasticity can be found using the excel function of graphing the trendline and acquiring the graphs equation. Finding yield stress is the same exact way. Yield stress is defined by study.com is All objects will begin experiencing elastic deformation at first, but once the stress on the object exceeds a certain amount, it will experience plastic deformation. When that switch happens, the object has reached its yield stress. The yield stress is $6E+06$ based on the equation of the line plotted from the yield stress. Before getting this equation, the offset line is required. Since the graph shows the yield stress without any calculations it's difficult to have a definite value

without using the .2% offset rule. Once .2% offset is calculated the line in the graph will give you the value stated above.

Ultimate stress is known as the highest amount of stress a property can go through before it starts to lead to fractured stress according to <https://www.corrosionpedia.com/>. In the first graph in figure 7 the ultimate stress can be found just by merely looking at the graph. The x and y value of the ultimate stress is, (.077611, 75992.31).

Fractured stress is very similar in terms of how it is found. Both values can be found by just looking at an accurate stress vs strain graph. The fractured stress is the point on the graph right before reaching a state of necking. The point of fractured stress is (.144979, 56751.54).

L

Appendix A**Table of contents: Page 2****Appendix B****Abstract: page 3****Appendix C****Introduction: page 3****Appendix: D****Theory: Page 4-5****Appendix D****Test Results: page 6-8****Figure 1****Figure 2****Figure 3****Figure 4****Figure 5**

Figure 6

Figure 7

Figure 8

Appendix E

Test result explanation: page 9-10

Modulus of Elasticity ($8E+06$)

Yield Stress($6E+06$)

Ultimate Stress (.077611,75992.31)

Fractured Stress (.144979,56751.54

Appendix F

Conclusion: Page 13

Appendix G

Resources: page 14

Sample
calculation

Conclusion

To conclude, given the data points of Force and Displacement. You can calculate stress and strain in order to plot a graph. When the graph is obtained, the modulus of elasticity, yield stress, ultimate stress, and fractured stress will become visible based on the kind of graph. Since the graph for this lab report was clear and concise, one can see a visual representation of all the information needed for this lab instead of having to calculate each one. The calculated values are in order to find the exact point at which each is occurring. In result the steel has a good amount of elasticity before it reaches plasticity. Based on the graph you can concluded that since the ultimate stress is quite high this is a good material to use in order to complete building whats intended.



Resources

Corrosionpedia. "What Is an Ultimate Tensile Stress (UTS)? - Definition From Corrosionpedia."

Corrosionpedia, Corrosionpedia, 19 Mar. 2019,
www.corrosionpedia.com/definition/6283/ultimate-tensile-stress-uts.

"Take Online Courses. Earn College Credit. Research Schools, DEGREES & Careers."

Study.com | Take Online Courses. Earn College Credit. Research Schools, Degrees & Careers, study.com/academy/lesson/what-is-yield-stress-definition-formula.html.

"Take Online Courses. Earn College Credit. Research Schools, DEGREES & Careers."

Study.com | Take Online Courses. Earn College Credit. Research Schools, Degrees & Careers, study.com/academy/lesson/stress-strain-curve-definition-yield-point.html.

MechanicalLaboratory. "Stress-Strain Curve: How to Read the Graph?" *Fractory*, 5 May 2021,

fractory.com/stress-strain-curve/.



AVERAGE

A red handwritten signature, possibly reading 'FH', with a long horizontal stroke extending to the right.

Marshall Johnson

CVEG 2101 P81 2210

Mechanics of Materials Lab

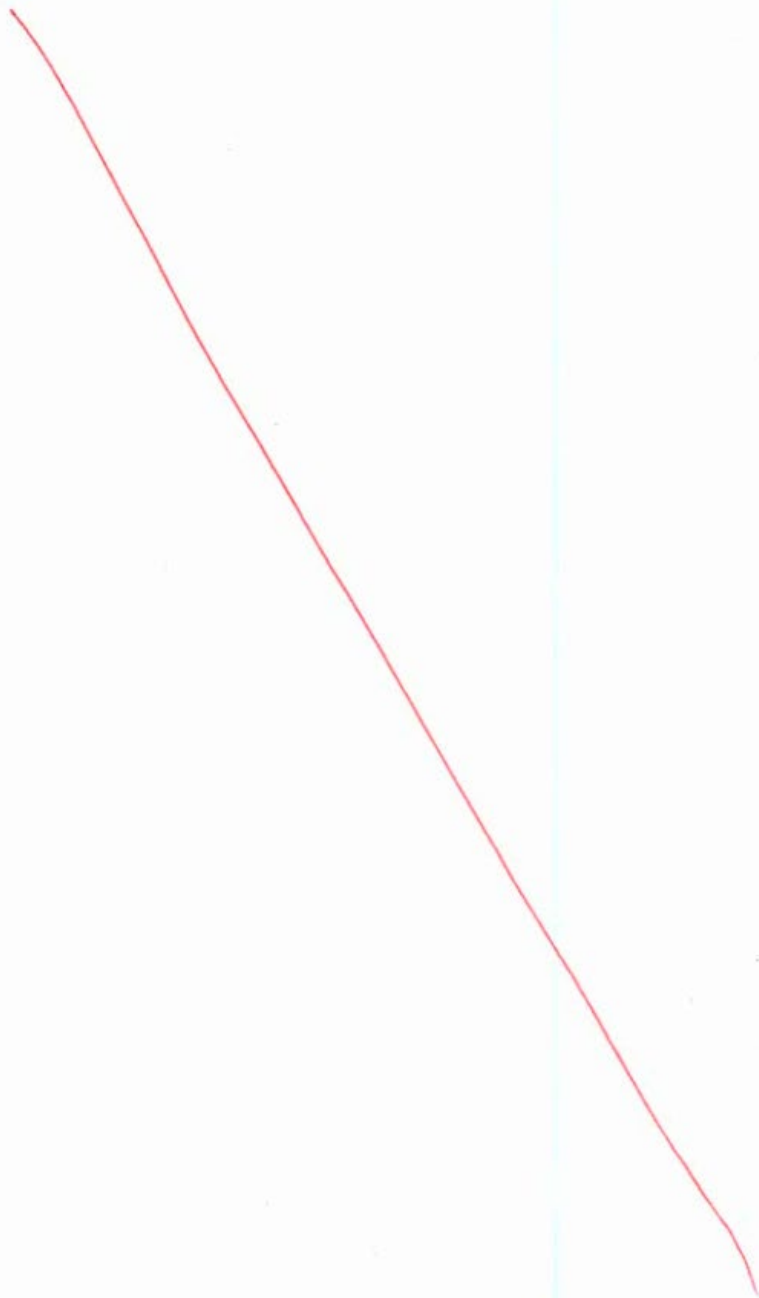
Lab Report 1

09/10/2021

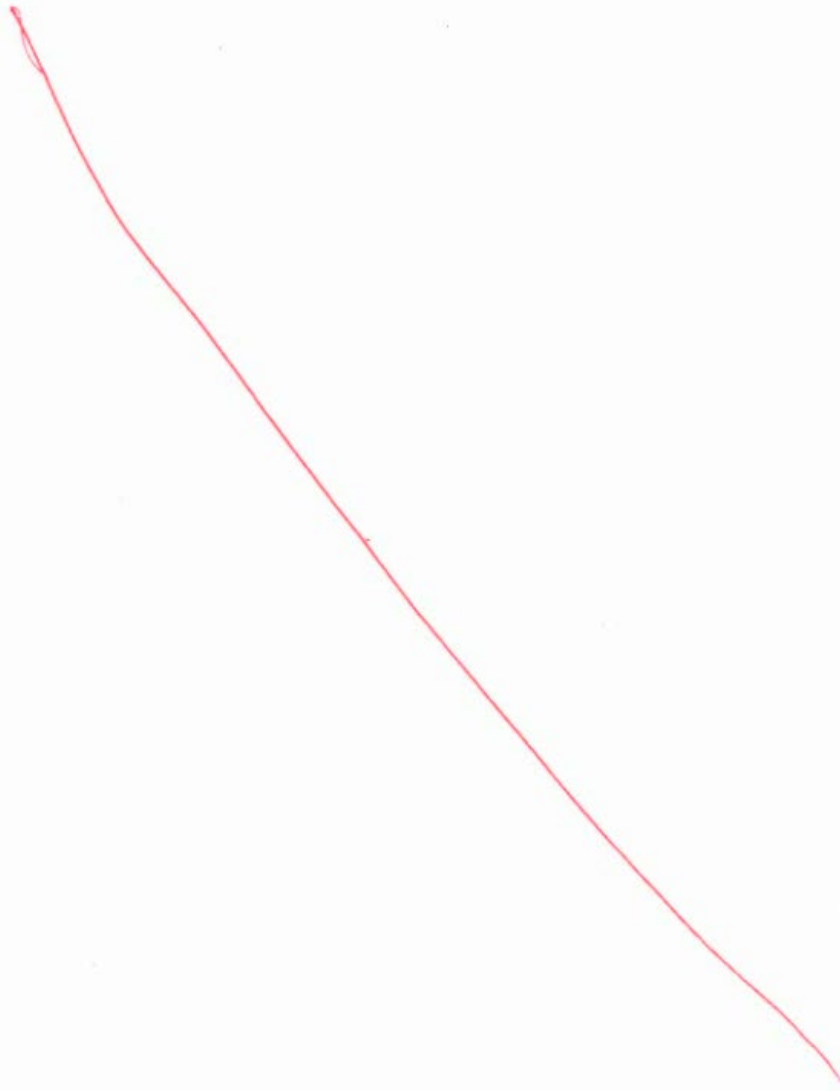
Table of Contents

1. Abstract....3
2. Introduction of Stress-Strain Theory....4
3. Test Procedure....5
4. Detail Results....6
5. Discussion of the Test Results....7
6. Appendices....8

Abstract



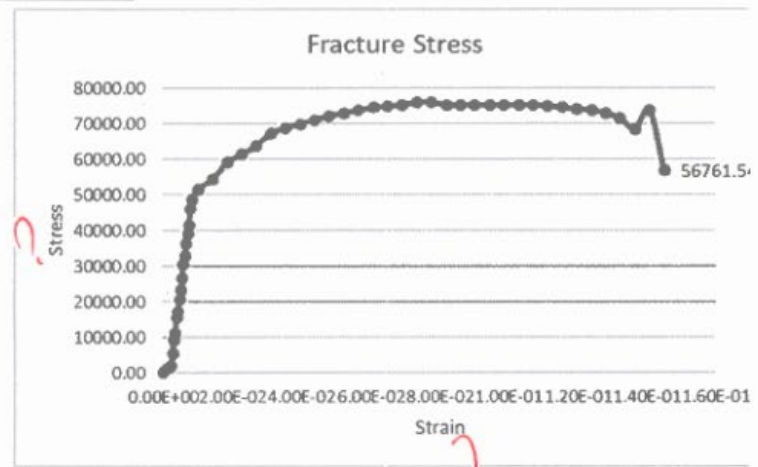
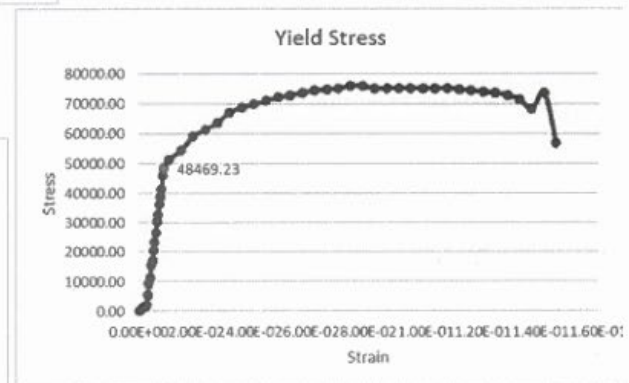
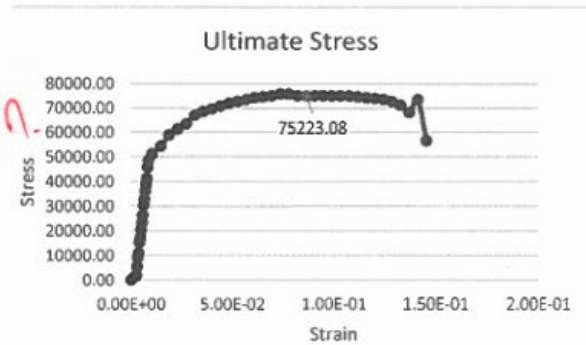
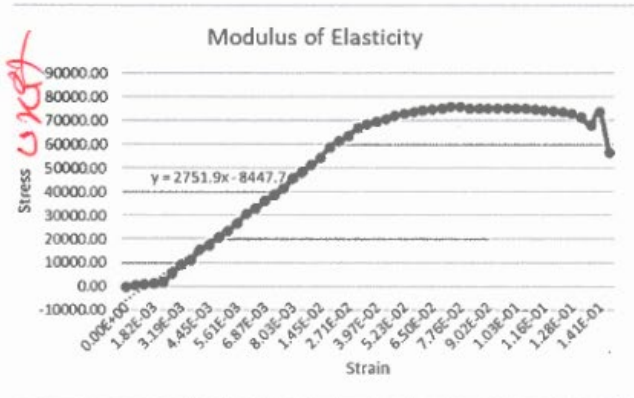
Introduction of Stress-Strain Theory



Test procedure

1. Measure length and diameter of 1018 steel
2. Calculate area of the cross-section of the steel stock sample ($(\pi \cdot D^2)/4$)
3. Create table with titles; Force (N), Displacement (mm), Stress (N/mm²), and Strain (No Units)
4. Calculate stress values by dividing the force by the area of the cross section of steel (F/A)
5. Calculate strain by dividing the displacement by the total length of the beam (Change in L/L) (this value should be unitless since it is a ratio of the change in dimensions)
6. Once all table values are calculated, sketch the Stress-Strain curve
7. Detail sketch of graph to find modulus of elasticity of the material (region on a Stress-Strain curve that indicates the elastic region, or region where material will return to normal if stretched)
8. Detail sketch of graph to the yield stress of the material (point on a Stress-Strain curve that indicates the limit to the elastic region)
9. Detail sketch of graph to find the ultimate stress of the material (point on a Stress-Strain curve where the material is stretched to its maximum without breaking)
10. Detail sketch of graph to find fracture stress of the material (point on a Stress-Strain curve where material breaks/ fractures)
11. Once all details are added to graphs, the report (which includes a table of contents, test, procedure, detail results, discussion of the test results, and appendices) is to be constructed to support and reflect on the experiment.

Detail Results



Discussion of Test Results

In response to the tests that have been done today, I can say that the desired result was accomplished. According to the relationship between stress and strain, I have found and proven the modulus of elasticity, yield stress, ultimate stress, and fracture stress. After the graphs were formulated in excel, I was able to determine that the modulus of elasticity is equal to $2.751.9 \text{ N/mm}^2$, the yield stress is $48,469.23 \text{ N/mm}^2$, the ultimate stress is 75223.08 N/mm^2 , and the fracture stress is at $56,761.54 \text{ N/mm}^2$.

sample calculation

Reference!



Appendices

BELOW AVERAGE

CVEG 2061

Material and Dynamics Lab Report I

Fall 2021

Experiment: Stress-Strain Curve

Submitted by: Erik Smith

Instructor: Dr. Jobair Alam

Due Date: 09-10-2021

Date Submitted: 09-10-2021

60

Background:

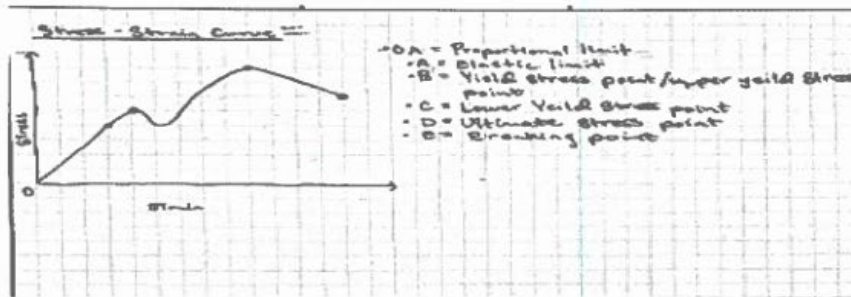
The Stress-Strain curve is a graphical way to visualize the reaction of a material when pressure is applied to it. One of its primary purposes is to show the comparison between stress and strain. As well as to visualize other properties of the material like modulus of elasticity and fracture point, as well as a few others. For this laboratory assignment, we students were given a full set of data from a tensile test on a 1018 steel stock sample. We were tasked with preparing a report showing the mechanical properties of the material being tested. The report must contain a detail sketch of the Stress-Strain Curve and within this sketch we must identify the modulus of elasticity, yield stress, ultimate stress and fracture stress of the material that was tested. We are also asked to provide a different curve in the report to show the different properties of the material as well as a sample calculation with the given data. Lastly we must format our work into a formal lab report for final submission.

Definitions And Significance:

- **Stress-Strain Curve**
 - o As mentioned above the Stress-Strain curve is a method used to find out about the properties and reactions of different material when put under pressure
- **Modulus of elasticity**
 - o The quantity that measures a substances resistance to being deformed elastically when stress is applied to it
- **Yield Stress**
 - o Is the value of stress at the yield point of the material
- **Ultimate Stress**
 - o Also known as Ultimate tensile strength is the maximum amount of stress that a material can with stand while being stretched or pulled before breaking
- **Fracture Stress**
 - o Also known as the breaking strength, this happens when a material is put under too much pressure and cause the material to break.

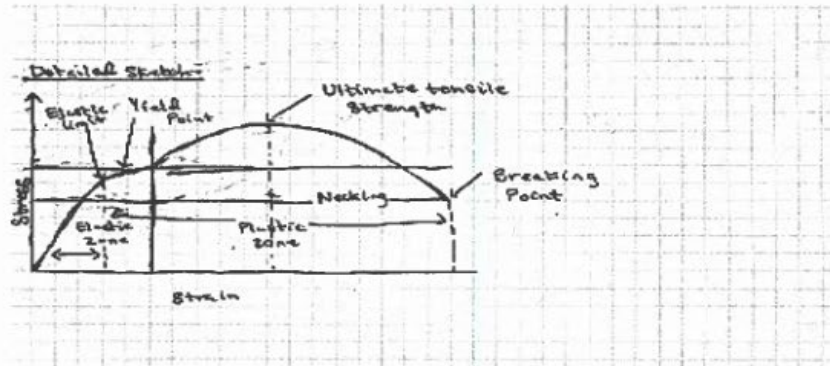
Materials and Methods:

- Basic example of Stress-Strain Curve below:



Scanned with CamScanner

- Example of Detailed Sketch of Stress-Strain Curve:



Scanned with CamScanner

References:

- The only references used are the given lab data and the textbook.

Analysis of Results:

- Sample Dimensions:

- Diameter of the steel: 0.41 mm
- Length of sample steel: 95 mm

Department of Civil & Environmental Engineering
CVRG 2061 Materials and Dynamics Lab

Force	Displacement	Force	Displacement
0.0	0.000	0.0	0.000
0.1	0.001	0.1	0.001
0.2	0.002	0.2	0.002
0.3	0.003	0.3	0.003
0.4	0.004	0.4	0.004
0.5	0.005	0.5	0.005
0.6	0.006	0.6	0.006
0.7	0.007	0.7	0.007
0.8	0.008	0.8	0.008
0.9	0.009	0.9	0.009
1.0	0.010	1.0	0.010
1.1	0.011	1.1	0.011
1.2	0.012	1.2	0.012
1.3	0.013	1.3	0.013
1.4	0.014	1.4	0.014
1.5	0.015	1.5	0.015
1.6	0.016	1.6	0.016
1.7	0.017	1.7	0.017
1.8	0.018	1.8	0.018
1.9	0.019	1.9	0.019
2.0	0.020	2.0	0.020
2.1	0.021	2.1	0.021
2.2	0.022	2.2	0.022
2.3	0.023	2.3	0.023
2.4	0.024	2.4	0.024
2.5	0.025	2.5	0.025
2.6	0.026	2.6	0.026
2.7	0.027	2.7	0.027
2.8	0.028	2.8	0.028
2.9	0.029	2.9	0.029
3.0	0.030	3.0	0.030
3.1	0.031	3.1	0.031
3.2	0.032	3.2	0.032
3.3	0.033	3.3	0.033
3.4	0.034	3.4	0.034
3.5	0.035	3.5	0.035
3.6	0.036	3.6	0.036
3.7	0.037	3.7	0.037
3.8	0.038	3.8	0.038
3.9	0.039	3.9	0.039
4.0	0.040	4.0	0.040
4.1	0.041	4.1	0.041
4.2	0.042	4.2	0.042
4.3	0.043	4.3	0.043
4.4	0.044	4.4	0.044
4.5	0.045	4.5	0.045
4.6	0.046	4.6	0.046
4.7	0.047	4.7	0.047
4.8	0.048	4.8	0.048
4.9	0.049	4.9	0.049
5.0	0.050	5.0	0.050
5.1	0.051	5.1	0.051
5.2	0.052	5.2	0.052
5.3	0.053	5.3	0.053
5.4	0.054	5.4	0.054
5.5	0.055	5.5	0.055
5.6	0.056	5.6	0.056
5.7	0.057	5.7	0.057
5.8	0.058	5.8	0.058
5.9	0.059	5.9	0.059
6.0	0.060	6.0	0.060
6.1	0.061	6.1	0.061
6.2	0.062	6.2	0.062
6.3	0.063	6.3	0.063
6.4	0.064	6.4	0.064
6.5	0.065	6.5	0.065
6.6	0.066	6.6	0.066
6.7	0.067	6.7	0.067
6.8	0.068	6.8	0.068
6.9	0.069	6.9	0.069
7.0	0.070	7.0	0.070
7.1	0.071	7.1	0.071
7.2	0.072	7.2	0.072
7.3	0.073	7.3	0.073
7.4	0.074	7.4	0.074
7.5	0.075	7.5	0.075
7.6	0.076	7.6	0.076
7.7	0.077	7.7	0.077
7.8	0.078	7.8	0.078
7.9	0.079	7.9	0.079
8.0	0.080	8.0	0.080
8.1	0.081	8.1	0.081
8.2	0.082	8.2	0.082
8.3	0.083	8.3	0.083
8.4	0.084	8.4	0.084
8.5	0.085	8.5	0.085
8.6	0.086	8.6	0.086
8.7	0.087	8.7	0.087
8.8	0.088	8.8	0.088
8.9	0.089	8.9	0.089
9.0	0.090	9.0	0.090
9.1	0.091	9.1	0.091
9.2	0.092	9.2	0.092
9.3	0.093	9.3	0.093
9.4	0.094	9.4	0.094
9.5	0.095	9.5	0.095
9.6	0.096	9.6	0.096
9.7	0.097	9.7	0.097
9.8	0.098	9.8	0.098
9.9	0.099	9.9	0.099
10.0	0.100	10.0	0.100

Scanned with CamScanner

Conclusion:

data analysis?
graph?
calculation?

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 2 – Laboratory Assignment #2 - Spring Constant Test

TOPICS COVERED IN LABORATORY ASSIGNMENT 2

Laboratory Assignment 2 covered the following topics:

1. Spring Constant (k)
2. Work Done (W)
3. Graphical Method
4. Analytical Method

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 2 – Spring Constant Test
Given: September 10, 2021
Due September 17, 2021 no later than 11:00 PM

Instructions: Report Due Date: September 17, 2021 before 11: 00 PM. Students will need to create a file as shown below.

file: Last name (space) First name (space) Spring Constant Test Lab CVEG 2101

Upload to: CVEG 2101-P81 CANVAS portal under Assignment: Lab Report # 2 - Spring Constant test

A full set of experimental data from a Spring Constant test of a steel spring are provided. The test results are provided in the following tables.

Prepare a report showing the following.

1. Determine the Spring Constant (k) of the steel spring based on the experimental data.
2. Show detail graphical representation on the data and analysis to find k.
3. Show the table you will generate during your analysis.
4. Determine the work done (W) by the spring at different loading from graphical method and analytical method and compare the % deviation of the two methods.
5. Show one sample calculation of your analysis.
6. A professional report must be submitted (e.g., table of contents, introduction of theory, detail results, discussion of the test results, appendices etc. should be included in the report)

NOTE: QUALITY OF YOUR WORK AND PRESENTATION WILL BE TAKEN INTO ACCOUNT FOR GRADING OF THIS REPORT

Mass in grams (m)	Initial Position (X_i)	Final Position (X_f)
g	cm	cm
0	7.5	7.5
1500	7.5	7.8
3000	7.5	8
4500	7.5	8.42
6000	7.5	8.7
7500	7.5	8.95
9000	7.5	9.24
10000	7.5	9.55

GRADING SCHEME FOR ASSIGNMENT

Prairie View A&M University

Roy G. Perry College of Engineering

Civil & Environmental Engineering Department

CVEG 2101- Materials & Dynamics Lab

Lab Assignment – 2 – Spring Constant Test

Given: September 10, 2021

Due September 17, 2021 no later than 11:00 PM

1. Your lab report should have the following on the cover page
 - a. Your name and roster number
 - b. Course prefix, number, section, and title
 - c. Homework number
 - d. Date given
 - e. Date due
2. Lab report template
 - a. Table of Content
 - b. Abstract
 - c. Introduction
 - d. Theory
 - e. Test Procedure
 - f. Detail Results
 - g. Discussion of Test Results
 - h. Appendices
 - i. References
3. Show all Steps for arriving the final answers
4. Reference all figures, tables, constant values, equation and conversion
5. Show units

Graded by Dr. Alam

Student 1 – Incomplete graph, missing calculation - (Grade 90)

Student 2 – Missing graph, missing test procedure, missing theory, missing results, missing calculation – (Grade 65)

Student 3 – Incomplete graph, missing calculation - (Grade 95)

Student 4 – Incomplete graph, missing calculation - (Grade 90)

Student 5 – Missing graph, missing calculation, missing appendices - (Grade 65)

Student 6 – Missing test procedure, missing theory, missing calculation - (Grade 80)

Student 1 – Missing graph, missing results, missing calculation, missing references - (Grade 60)

ABOVE AVERAGE



95

Omar Hajo

Mechanics of Materials 2332

Dr. Jobair

Lab Report 2: Spring Constant/ Work

09/23/2021

TABLE OF CONTENTS

INTRODUCTION	PAGE 3
ABSTRACT	PAGE 3
Theory	PAGE 3/ 4
RESULTS	PAGE 5/6
TEST RESULTS EXPLANATION	PAGE 6
APPENDIX	PAGE 7/8
CONCLUSION	PAGE 9
RESOURCES	PAGE 10

Abstract

The purpose of this lab is to obtain the spring constant and work done using the data points provided. From the graphing method all values turned out to be identical to the analytical method. The results obtained analytically are the spring constant (k) is 5017.101N/m and the work (J) done by the spring calculated graphically is .4922J. When work is calculated analytically its averaged to .4922J. The percent deviation is 0%.

Introduction

The purpose of this lab is to obtain the spring constant and the work done. In any mechanical device a certain force is used in order to expand/ compress a spring. The force used to reflect this result is done by the spring constant. The formula $k=F/x$. According to jamespring.com this formula is understood as "F is the force applied, k is the spring constant and measures how stiff and strong the spring is proportionally, and x is the distance the spring is stretched or compressed away from its equilibrium or rest position usually in Newton per meter (N/m)". Portion two is to find work and according to cs.mcgill.ca work is defined as "the amount of energy transferred by a force. Like energy, it is a scalar quantity, with ~~SI~~ units of joules".

Theory

$$F_g = mg$$

(www.wired.com)

$$F_s = -kx$$

F_s = spring force

k = spring constant

x = spring stretch or compression

From the web

The formula to calculate the spring constant is as follows: $k = -F/x$, where k is the spring constant. F is the force and x is the change in spring's length. The negative sign indicates that work is done against the restoring force.

(<https://www.vedantu.com/>)

$$W = \frac{1}{2} \times ke \times e = \frac{1}{2}ke^2$$

(strobertsphysics.wordpress.com)

Results

Graph 1

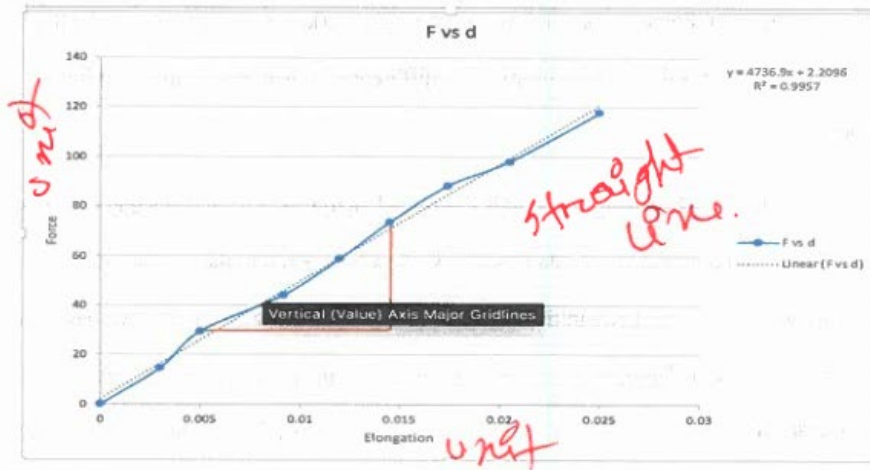


Figure 2

						k	4736.900	N/m			W	0.49227125
Mass in grams	Mass in Kilo Grams (m)	Force in Newtons, F=mg	Initial Position Xi centimeters	Initial Position Xf centimeters	Final Position Xf centimeters	Final Position Xf centimeters	Elongation in meters (d)	Spring Constant (k) Newtons/meter	Work Done by Spring 0.5*k*d ² analytically	Work(W) Graphical method	% Deviation between Graphical and analytical	
g	kg	N	cm	m	cm	m	m	(N/m)	N-m	N/m		
0	0	0	7.5	0.075	7.5	0.075	0	0	0	0	0	
1500	1.5	14.715	7.5	0.075	7.8	0.078	0.003	4905.00	0.0220725	0.0220725		
3000	3	29.43	7.5	0.075	8	0.08	0.005	5886.00	0.073575	0.073575		
4500	4.5	44.145	7.5	0.075	8.42	0.0842	0.0092	4798.37	0.203067	0.203067		
6000	6	58.86	7.5	0.075	8.7	0.087	0.012	4905.00	0.353160	0.35316		
7500	7.5	73.575	7.5	0.075	8.95	0.0895	0.0145	5074.14	0.539419	0.53941875		
9000	9	88.29	7.5	0.075	9.24	0.0924	0.0174	5074.14	0.768123	0.768123		
10000	10	98.1	7.5	0.075	9.55	0.0955	0.0205	4785.37	1.005525	1.005525		
12000	12	117.72	7.5	0.075	10	0.1	0.025	4708.80	1.471500	1.4715		

Figure 3

k	4736.900	N/m	W	0.49227125	J
---	----------	-----	---	------------	---

Test result explanation

Obtaining Graph 1 required a conversion between grams(g)-kilograms(kg) and centimeters(cm)-meters(m). Once the conversions are done accurately then inputting the values will result in having a clear and concise graph. Referring to Graph 1 the y and x values are based on force vs elongation. Force is obtained by calculating mass(kg) times constant g which is 9.8m/s^2 . Getting the x values (elongation) is the difference in final position(m) and initial position(m).

In result finding the spring constant is calculated analytically after force and elongation is obtained. The formula for spring constant is $k=F/x$, the x is referred to the displacement (elongation) between the final and initial length of the spring. Spring constant(k) values are found on figure 2 in units N/m. The spring constant(k) is 4736.9N/m . This value is attained by first plotting the data points in Figure 2 and using the excel function (quick layout) to find the slope. Once the slope is found the spring constant is equal to that result.

In Figure 2 work is calculated using both graphical and analytically. Using the graphical method means finding the area between the line from between each point. The formula $(\frac{1}{2}) * F * D$ provided the results for work done by the spring. On the contrary work is also calculated analytically using the equation $(\frac{1}{2}) * F * d^2$. The average work done in the spring is .4922J The difference between these two results is slim to being that the values are almost similar. Using the excel tool STDEV (standard deviation) the percent value of the work done is 0%

Appendix A

Table of contents: Page 2

Appendix B

Abstract: page 3

Appendix C

Introduction: page 3

Appendix: D

Theory: Page 3/4

Appendix D

Results: page 4/5

Figure 1

Figure 2

Figure 3

Appendix E

Test result explanation: page 6

Spring constant(k)= 5017.101 N/m

Work(w)= .4922 J

Percent deviation= 50.27%

Appendix F

Conclusion: Page 9

Appendix G

Resources: page 10

Conclusion

The purpose of this lab was to use a set of data points to obtain the spring constant(k), work(w), and the percent deviation between calculating graphically and analytically. In result the values obtained are spring constant being(k) 5017.101 N/m, work(w) being .4922 J, and percent deviation being 50.27%. In conclusion it is more fit to find the work using the analytical method of calculation. The reason being is that the percent deviation between both methods is almost 50% which means there was a big difference in calculation.

Resources

June 4, 2018. "What Is Spring Constant and How Is the Formula Calculated?" *What Is Spring Constant and How Is the Formula Calculated?*, 11 July 2019, www.jamesspring.com/news/spring-constant/.

"Work Done from Force-Displacement Graphs." *St Roberts GCSE Physics*, 26 Jan. 2019, strobertsphysics.wordpress.com/work-done-from-force-distance-graphs/.

Vedantu. "Spring Constant Formula." *VEDANTU*, Vedantu, 29 Dec. 2020, www.vedantu.com/formula/spring-constant-formula.

Wired, Conde Nast, www.wired.com/.

Mechanical Work, www.cs.mcgill.ca/~rwest/wikispeedia/wpcd/wp/m/Mechanical_work.htm.

AVERAGE

Prairie View A&M University



80

CVEG 2101

Materials and Dynamics Lab

Section: P81

Assignment #2

Assigned: September 10, 2021

Due: September 23, 2021

Submitted By: Ariana Mangroo

Submitted to: Professor Md Alam

Table Of Contents

Cover Page.....	1
Table of Contents.....	2
Introduction.....	3
Graphs.....	4
Conclusion	5
Sources.....	6

Introduction

A spring constant is how stiff a spring is. It is determined by the amount of force applied to the spring and the amount of displacement made while doing so. The stiffer the spring is, the higher the constant will be. If a spring has force applied to it, it compresses to the side force is being applied to it because of its elasticity. The other side of the spring then exerts the force for the length to get back to its original size.

Formula: $k = -F/x$

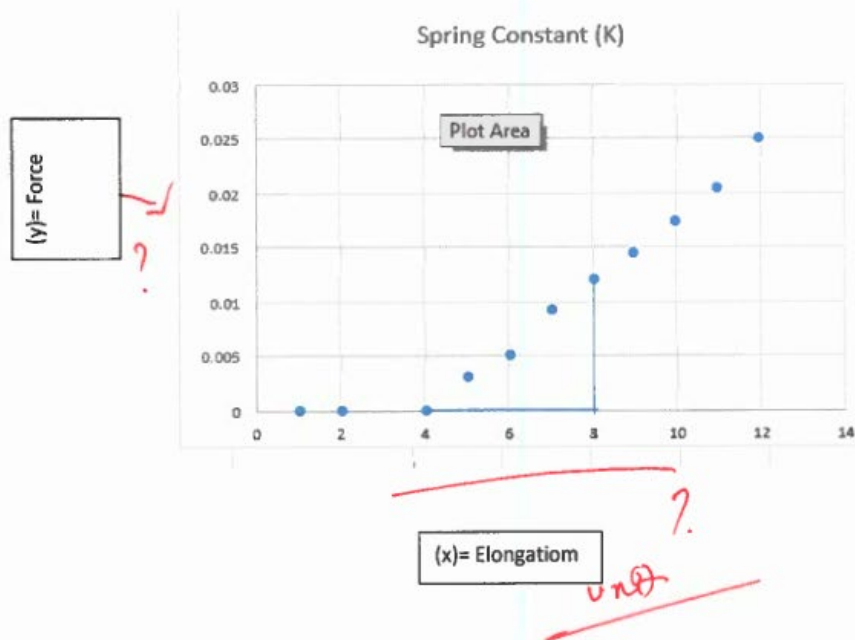
test procedure?

Given:

Mass in grams	Mass in Kilo Grams (m)	Force in Newtons $F=W=mg$	Initial Position Xi centimeters	Initial Position Xi centimeters	Final Position Xf centimeters	Final Position Xf centimeters
g	kg	N	cm	m	cm	m
0	0	0	7.5	0.075	7.5	0.075
1500	1.5	14.715	7.5	0.075	7.8	0.078
3000	3	29.43	7.5	0.075	8	0.08
4500	4.5	44.145	7.5	0.075	8.42	0.0842
6000	6	58.86	7.5	0.075	8.7	0.087
7500	7.5	73.575	7.5	0.075	8.95	0.0895
9000	9	88.29	7.5	0.075	9.24	0.0924
10000	10	98.1	7.5	0.075	9.55	0.0955
12000	12	117.72	7.5	0.075	10	0.1

Graphs

Elongation in meters (d)	Spring Constant (k) Newtons/meter	Work Done by Spring $0.5 \cdot k \cdot d^2$
m	(N/m)	N-m
0	0	0
0.003	4905.00	0.022
0.005	5886.00	0.074
0.0092	4798.37	0.203
0.012	4905.00	0.353
0.0145	5074.14	0.533
0.0174	5074.14	0.768
0.0205	4785.37	1.005
0.025	4708.80	1.472



Conclusion

In conclusion, we used Hooke's law to find the value of the spring constant shown in the graph and chart above. The spring constant is the stiffness of the spring so it can never be negative. We find the constant by solving for k in the force formula given. If the spring constant is zero there is no force being applied to the spring. In this lab the spring constant was continuously increasing as shown in both the table and graph.

*sample
calculation
?*

Works Cited

Mechanics of Materials + Masteringengineering with Pearson Etext Access Card. Pearson College Div, 2016.

Vedantu. "Spring Constant." *VEDANTU*, Vedantu, 9 July 2020, www.vedantu.com/physics/spring-constant.

BELOW AVERAGE

CVEG 2061

Material and Dynamics Lab Report 2

Fall 2021

Experiment: Spring Constant

Submitted by: Erik Smith

Instructor: Dr. Jobair Alam

Due Date: 09-17-2021

Date Submitted: 09-17-2021

60

Table of Contents

Introduction of Theory.....	page 1
Definitions and significance.....	page 1
Detailed Results.....	page 2
Analysis of Results.....	page 3
Conclusion.....	page 3
References.....	page 3

Introduction of Theory:

For this lab we were tasked to observe and report about the different characteristics of the Spring Constant shown in the data. The spring constant can be defined as the force needed to stretch a spring divided by the distance that the spring gets longer or shorter. Or more simply known as the stiffness of the spring.

The Spring Constant goes hand in hand with Hooke's law, which was developed by Robert Hooke in the 1600's. His findings show that the force required to stretch an elastic object is directly proportional to the extension of the spring. The formula for Hooke's law is $[F = -kx]$ which is the spring constant multiplied by the length of extension or compression. The "k" in this equation is the spring constant and without it there would be no Hooke's law.

For this report we were asked to complete six tasks based on experimental data that was given to us. First we should determine the Spring Constant of the steel spring and show a detailed graph representation of the data and analysis of k. As well as showing the table that was generated during the analysis. Next we are tasked to determine the work done by the spring at a different loading from graphical method and analytical method and compare the % deviation of the two methods and show one sample calculation of your analysis. After this we must convey our data in a professional report.

Definitions And Significance:

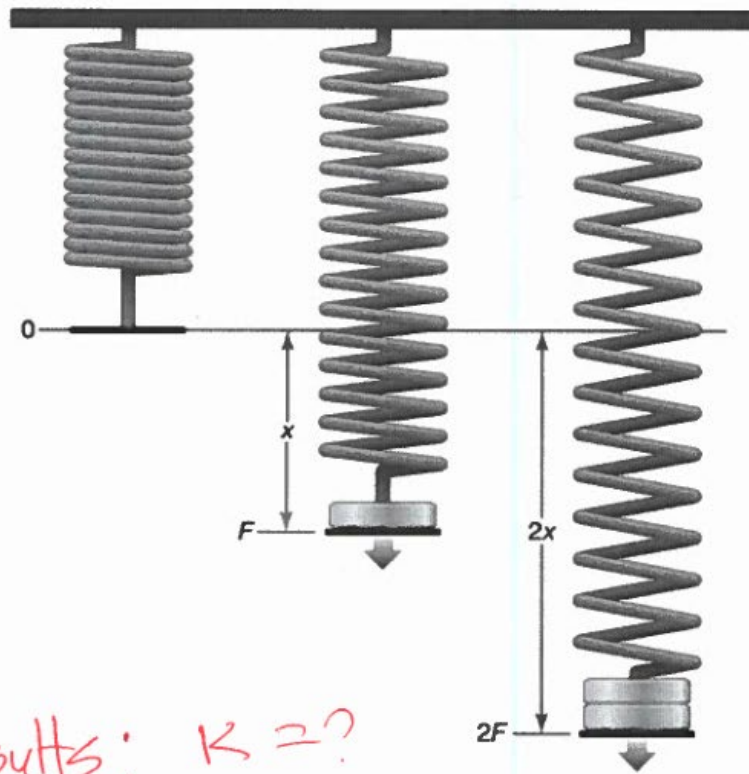
- Hooke's Law:

- is a principle of physics that states that the force needed to extend or compress a spring by some distance is proportional to that distance. The mathematical formula for this principle is ($F = -k \cdot x$). F is the force applied to the spring, x is the length of extension or compression and k is the spring constant
- Spring Constant:
 - Is the number that represents the force it takes to stretch a certain material, the larger the number the stiffer the material.

Detailed Results:

- The table below shows the given lab data:

Mass in grams (m)	Initial Position (X_i)	Final Position (X_f)
g	cm	cm
0	7.5	7.5
1500	7.5	7.8
3000	7.5	8
4500	7.5	8.42
6000	7.5	8.7
7500	7.5	8.95
9000	7.5	9.24
10000	7.5	9.55
12000	7.5	10



Results: $K = ?$
calculation: _____

Analysis of Results:

Conclusion:

After review and analysis of the lab data, I have come to the conclusion that

References:

- <https://www.khanacademy.org/science/physics/work-and-energy/hookes-law/a/what-is-hookes-law>
- <https://phys.org/news/2015-02-law.html>
- <https://study.com/academy/lesson/hookes-law-the-spring-constant-definition-equation.html>

**MATERIALS & DYNAMICS LAB
FALL 2021**

ASSIGNMENT 3 – Laboratory Assignment #3 - Torsion Test

TOPICS COVERED IN LABORATORY ASSIGNMENT 3

Laboratory Assignment 3 covered the following topics:

1. Introduction to Torsion
2. Torque
3. Shear Stress
4. Twist Angle
5. Test Using Motorized Torsion Test Equipment

ASSIGNMENT STATEMENT/QUESTIONS

Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 3 – Torsion Test
Given: September 17, 2021
Due September 30, 2021 no later than 11:00 PM

Instructions: Report Due Date: September 30, 2021 before 11: 00 PM. Students will need to create a file as shown below.

file: Last name (space) First name (space) Torsion Lab CVEG 2101

Upload to: CVEG 2101-P81 CANVAS portal under Assignment: Lab Report # 3 - Torsion Test

Activities

- Introduction to Torsion
- Torque, Shear Stress and Twist Angle
- Test using Motorized Torsion Test Equipment
- Handout: Data sheet with angle of twist and torque

$$1 \text{ degree} = (\pi/180) \text{ radian}$$
$$\underline{x} \text{ degree} = \underline{x} * (\pi/180) \text{ radian}$$

G= Shear modulus of rigidity

L = length of specimen

L = 100 mm

d=30mm

c=15 mm

1 degree = ($\pi/180$) radian

$$\underline{x} \text{ degree} = \underline{x} * (\pi/180) \text{ radian}$$

Prepare a report as per the following requirements:

Part (a):

- Use the Lab Report Format
- Compute Shear Stress

Revolution	Angle of twist degree	Angle of twist radian	Torque N-m	Torque N-mm	Shear stress N/mm ²
R	Φ	Φ	T		ζ

- Compute Modulus of Rigidity Values
- Plot graph

- Draw graph showing shear stress and angle of twist using appropriate scale
- Compute Modulus of Rigidity Values
- Compare and give your conclusions and comments

Part (b):

Torsion Test using Non-Motorized (Hand operated EQUIPMENT to perform Torsion Test will occur on September 24, 2021 for 15 minutes).

Use the data collected from this test. Follow the same procedure as given in Part (a)

Additional Torsion Test Resources.

- https://youtu.be/jpogdcw_Uh0?t=2
- <https://www.youtube.com/watch?v=1YTKedLQOa0>
- <https://www.educationalstuffs.in/strength-of-materials-torsion-test/>
- http://orionscience.es/wp-content/uploads/2015/09/orion_torsion_student_ing_2014.pdf
- <https://www.youtube.com/watch?v=7DABoi4mga8> (6 minutes)
- <https://www.youtube.com/watch?v=NCRhEMQfq-4> (14 minutes)

TORSION TEST

Aim:- To conduct torsion test on mild steel.

Apparatus:-

1. A torsion test machine along with angle of twist measuring attachment.
2. Standard specimen of mild steel.
3. Steel rule.
4. Vernier caliper or a micrometer.

Theory:- For transmitting power through a rotating shaft it is necessary to apply a turning force. The force is applied tangentially and in the plane of transverse cross section. The torque or twisting moment may be calculated by multiplying two opposite turning moments. It is said to be in pure torsion and it will exhibit the tendency of shearing off at every cross section which is perpendicular to the longitudinal axis.

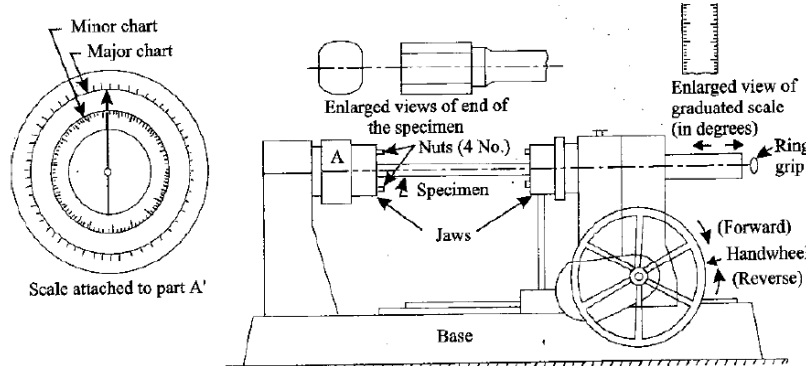


Fig:- Torsion Testing Machine

Torsion equation:-

$$T/J = \tau/R = G\theta/L$$

$$G = T L / J \theta \text{ N/mm}^2$$

T = maximum twisting torque (N mm)

J = polar moment of inertia (mm^4) = $\pi d^4/32$

τ = shear stress (N/mm^2)

G = modulus of rigidity (N/mm^2)

θ = angle of twist in radians

L = length of shaft under torsion (mm)

Procedure:-

1. Select the driving dogs to suit the size of the specimen and clamp it in the machine by adjusting the length of the specimen by means of a sliding spindle.
2. Measure the diameter at about three places and take the average value.
3. Choose the appropriate range by capacity change lever
4. Set the maximum load pointer to zero.
5. Set the protractor to zero for convenience and clamp it by means of knurled screw.
6. Carry out straining by rotating the hand wheel in either direction.
7. Load the machine in suitable increments.
8. Then load out to failure as to cause equal increments of strain reading.
9. Plot a torque- twist (T- θ) graph.
10. Read off co-ordinates of a convenient point from the straight line portion of the torque twist (T- θ) graph and calculate the value of G by using relation.

Precautions:-

- 1) Measure the dimensions of the specimen carefully
- 2) Measure the Angle of twist accurately for the corresponding value of Torque.
- 3) The specimen should be properly to get between the jaws.
- 4) After breaking specimen stop to m/c.

Observations:-

Gauge length of the specimen, L =

Diameter of the specimen, d =

Polar moment of inertia, $J = \pi d^4/32 = \dots\dots\dots$

Tabulation:-

Sl. No.	Torque, Kg-cm	Torque, N - mm	Angle of twist		Modulus Rigidity, G N/mm ²	Average G, N/mm ²
			Degrees	Radians		

Result :- Thus the torsion test on given mild steel specimen is done and the modulus of rigidity is -----N/mm².

Revolution	angle of twist	of two	Torque	Torque	Shear stress
R	degree	radian	N-m	N-mm	N/mm ²
0	0	0	0	0	0
1	0.3	0.005236	0.21	21	
2	0.6	0.010472	0.51	51	
3	0.9	0.015708	0.63	63	
4	1.2	0.020944	0.9	90	
5	1.5	0.02618	1.32	132	
6	1.8	0.031416	1.41	141	
7	2.1	0.036652	1.8	180	
8	2.4	0.041888	2	200	
9	2.7	0.047124	2.2	220	
10	3	0.05236	2.54	254	
11	3.3	0.057596	2.95	295	
12	3.6	0.062832	3.1	310	
13	3.9	0.068068	3.31	331	
14	4.2	0.073304	3.61	361	
15	4.5	0.07854	3.64	364	
16	4.8	0.083776	3.94	394	
17	5.1	0.089012	4.11	411	
18	5.4	0.094248	4.56	456	
19	5.7	0.099484	4.84	484	
20	6	0.10472	5.2	520	
21	6.3	0.109956	5.21	521	
22	6.6	0.115192	5.23	523	
23	6.9	0.120428	5.28	528	
24	7.2	0.125664	5.35	535	
25	7.5	0.1309	5.39	539	
26	7.8	0.136136	5.42	542	
27	8.1	0.141372	5.51	551	
28	8.4	0.146608	5.68	568	
29	8.7	0.151844	5.69	569	
30	9	0.15708	5.78	578	
31	9.3	0.162316	5.8	580	
32	9.6	0.167552	5.8	580	
33	9.9	0.172788	5.81	581	
34	10.2	0.178024	5.832	583.2	
35	10.5	0.18326	5.833	583.3	
36	10.8	0.188496	5.84	584	
37	11.1	0.193732	5.84	584	
38	11.4	0.198968	5.84	584	
39	11.7	0.204204	5.856	585.6	
40	12	0.20944	5.86	586	
41	12.3	0.214676	5.861	586.1	
42	12.6	0.219912	5.862	586.2	
43	12.9	0.225148	5.862	586.2	
44	13.2	0.230384	5.869	586.9	
45	13.5	0.23562	5.876	587.6	
46	13.8	0.240856	5.884	588.4	
47	14.1	0.246092	5.888	588.8	
48	14.4	0.251328	5.888	588.8	
49	14.7	0.256564	5.889	588.9	
50	15	0.2618	5.9	590	

$$J = \frac{\pi}{2} c^4$$

$$\phi = \frac{TL}{JG}$$

$$\tau_{\max} = \frac{Tc}{J}$$

GRADING SCHEME FOR ASSIGNMENT
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 3 – Torsion Test
Given: September 17, 2021
Due September 30, 2021 no later than 11:00 PM

1. Your lab report should have the following on the cover page
 - a. Your name and roster number
 - b. Course prefix, number, section, and title
 - c. Homework number
 - d. Date given
 - e. Date due
2. Lab report template
 - a. Table of Content
 - b. Abstract
 - c. Introduction
 - d. Theory
 - e. Test Procedure
 - f. Detail Results
 - g. Discussion of Test Results
 - h. Appendices
 - i. References
3. Show all Steps for arriving the final answers
4. Reference all figures, tables, constant values, equation and conversion
5. Show units

Graded by Dr. Radhakrishnan

Student 1 – Incomplete Theory, missing calculations, missing data for part B - (Grade 75)
Student 2 – Missing calculations, missing data for part B - (Grade 79)
Student 3 – Missing calculation - (Grade 89)
Student 4 – Incomplete Introduction, missing calculation, missing data for part B - (Grade 85)
Student 5 – Incomplete Introduction, missing calculation - (Grade 85)
Student 6 – Missing data, missing calculation - (Grade 70)

ABOVE AVERAGE



Omar Hajo ✓

Mechanics of Materials 2332

Dr. Radha

Lab Report 3: Torsion Test ✓

09/27/2021

89 for 100 ✓

TABLE OF CONTENTS

INTRODUCTION

PAGE 3

ABSTRACT

PAGE 3

THEORY

PAGE 4-5

RESULTS

PAGE 6-9

TEST RESULTS EXPLANATION

PAGE 10-11

APPENDIX

PAGE 12-13

CONCLUSION

PAGE 14

RESOURCES

PAGE 15

Abstract

The purpose of this lab is to obtain the modulus of rigidity of a set of data derived from the torsion test. The two results come from part 1 and part 2 of data. Part 1 is data given straight from the professor and part 2 is data derived from equipment done to conduct the torsion test manually. In result the average modulus of rigidity for part 1 is 4.732886589 Pa and the average modulus of rigidity for part 2 is 26.31398427 Pa.

Introduction

The purpose of this lab is to obtain the modulus of rigidity of two different sets of data points. Part a is a set of data given directly from the Professor. Part b is derived using hand equipment that allows you to test torsion manually. According to byjus.com modulus of rigidity is “is the measure of the rigidity of the body, given by the ratio of shear stress to shear strain”. Modulus of rigidity is calculated by using the equation $G = TL/J\theta$. G is denoted as the modulus of rigidity. T is known as the torque and the L represents the length of the material. These two are divided by $J\theta$, which stands for the polar moment of inertia. The units that represent this calculation can be termed as pascal (Pa) or gigapascal (Gpa). Knowing the following information on how to calculate the modulus of rigidity only can be use after completing the torsion test. According to sciencedirect.com, torsion testing is defined as “the twisting of a sample along an axis and is a useful test for acquiring information like torsional shear stress, maximum torque, shear modulus, and breaking angle of a material or the interface between two materials”. This method was only used directly for part b and not part a since the data was completed already. An in-depth explanation is given in the test explanation portion of the lab.

Theory

According to the prompt given by the professor the theory behind the torsion test is "For transmitting power through a rotating shaft it is necessary to apply a turning force. The force is applied tangentially and in the plane of transverse cross section. The torque or twisting moment may be calculated by multiplying two opposite turning moments. It is said to be in pure torsion and it will exhibit the tendency of shearing off at every cross section which is perpendicular to the longitudinal axis." The figure below will give a visual representation of what is explained above.

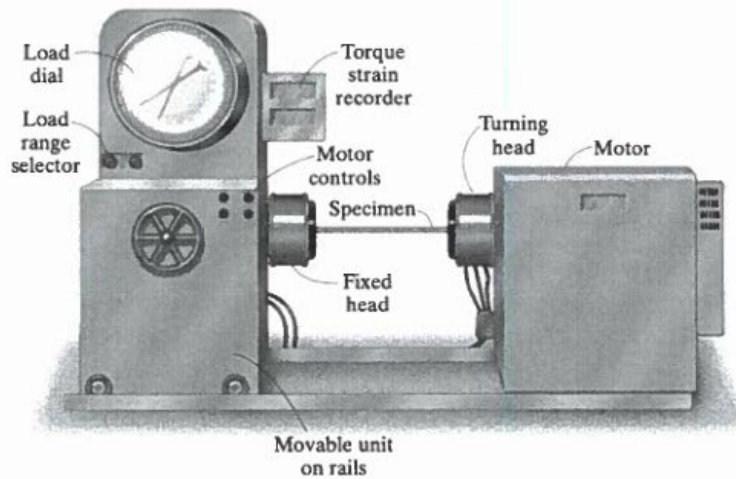


Fig. 5-14

(MECHANICS OF MATERIALS", by R. C. Hibbeler, 10 th ed. Prentice Hall)

Equations used:

Polar moment of inertia

$$J = \frac{\pi}{2} c^4$$

(MECHANICS OF MATERIALS", by R. C. Hibbeler, 10 th ed. Prentice Hall)

Modulus of rigidity

$$T/J = \tau/R = G\theta/L$$

$$G = T L/J \theta \text{ N/mm}^2$$

(Equation given in lab report)

Test Results

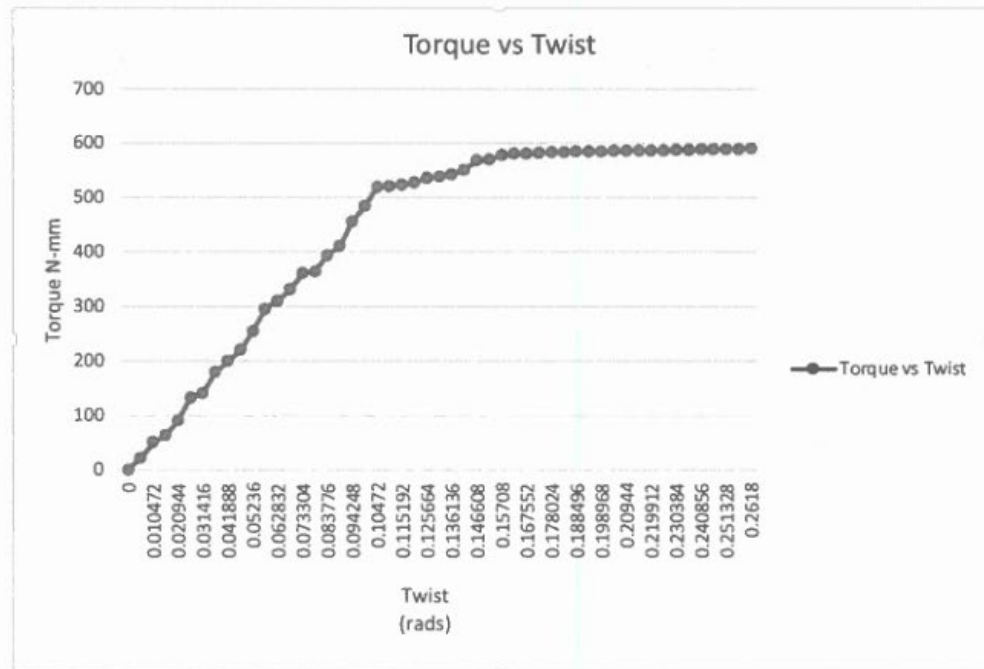
part a data:

Figure 1

Revolution	Angle of twist degree	Angle of twist radian	Torque N-m	Torque N-mm	Shear stress N/mm ²	Modulus of Rigidity N/mm ²	Average N/mm ²
R	Φ	Φ	T	T	τ	Pa	Pa
0	0	0	0	0	0	0	0
1	0.3	0.005236	0.21	21	0.00396119	5.04353157	4.732886589
2	0.6	0.010472	0.51	51	0.009620032	6.124288334	
3	0.9	0.015708	0.63	63	0.011883569	5.04353157	
4	1.2	0.020944	0.9	90	0.016976527	5.403783825	
5	1.5	0.02618	1.32	132	0.024898907	6.340439687	
6	1.8	0.031416	1.41	141	0.026596559	5.643951995	
7	2.1	0.036652	1.8	180	0.033953055	6.175752942	
8	2.4	0.041888	2	200	0.037725616	6.004204249	
9	2.7	0.047124	2.2	220	0.041498178	5.870777488	
10	3	0.05236	2.54	254	0.047911532	6.100271517	
11	3.3	0.057596	2.95	295	0.055645284	6.440873649	
12	3.6	0.062832	3.1	310	0.058474705	6.204344391	
13	3.9	0.068068	3.31	331	0.062435895	6.115051097	
14	4.2	0.073304	3.61	361	0.068094737	6.192907812	
15	4.5	0.07854	3.64	364	0.068660621	5.828080925	
16	4.8	0.083776	3.94	394	0.074319464	5.914141186	
17	5.1	0.089012	4.11	411	0.077526141	5.806418698	
18	5.4	0.094248	4.56	456	0.086014405	6.084260306	
19	5.7	0.099484	4.84	484	0.091295991	6.117968119	
20	6	0.10472	5.2	520	0.098086602	6.244372419	
21	6.3	0.109956	5.21	521	0.09827523	5.958457931	
22	6.6	0.115192	5.23	523	0.098652486	5.709452405	
23	6.9	0.120428	5.28	528	0.099595627	5.513425815	
24	7.2	0.125664	5.35	535	0.100916023	5.353748789	
25	7.5	0.1309	5.39	539	0.101670535	5.178025745	
26	7.8	0.136136	5.42	542	0.10223642	5.00658262	
27	8.1	0.141372	5.51	551	0.103934072	4.901209691	
28	8.4	0.146608	5.68	568	0.10714075	4.871982877	
29	8.7	0.151844	5.69	569	0.107329378	4.712265128	
30	9	0.15708	5.78	578	0.109027031	4.627240075	
31	9.3	0.162316	5.8	580	0.109404287	4.493468987	
32	9.6	0.167552	5.8	580	0.109404287	4.353048081	
33	9.9	0.172788	5.81	581	0.109592915	4.228415356	
34	10.2	0.178024	5.832	583.2	0.110007897	4.119590492	
35	10.5	0.18326	5.833	583.3	0.110026759	4.002574101	
36	10.8	0.188496	5.84	584	0.110158799	3.896061424	
37	11.1	0.193732	5.84	584	0.110158799	3.790762467	
38	11.4	0.198968	5.84	584	0.110158799	3.69100356	
39	11.7	0.204204	5.856	585.6	0.110460604	3.606217445	
40	12	0.20944	5.86	586	0.110536055	3.51846369	
41	12.3	0.214676	5.861	586.1	0.110554918	3.433233279	
42	12.6	0.219912	5.862	586.2	0.110573781	3.352061458	
43	12.9	0.225148	5.862	586.2	0.110573781	3.274106541	
44	13.2	0.230384	5.869	586.9	0.110705821	3.203515885	
45	13.5	0.23562	5.876	587.6	0.11083786	3.136062593	
46	13.8	0.240856	5.884	588.4	0.110988763	3.072064157	
47	14.1	0.246092	5.888	588.8	0.111064214	3.008745074	
48	14.4	0.251328	5.888	588.8	0.111064214	2.946062885	
49	14.7	0.256564	5.889	588.9	0.111083077	2.886429292	
50	15	0.2618	5.9	590	0.111290568	2.833984406	

Part a graph:

Graph 2



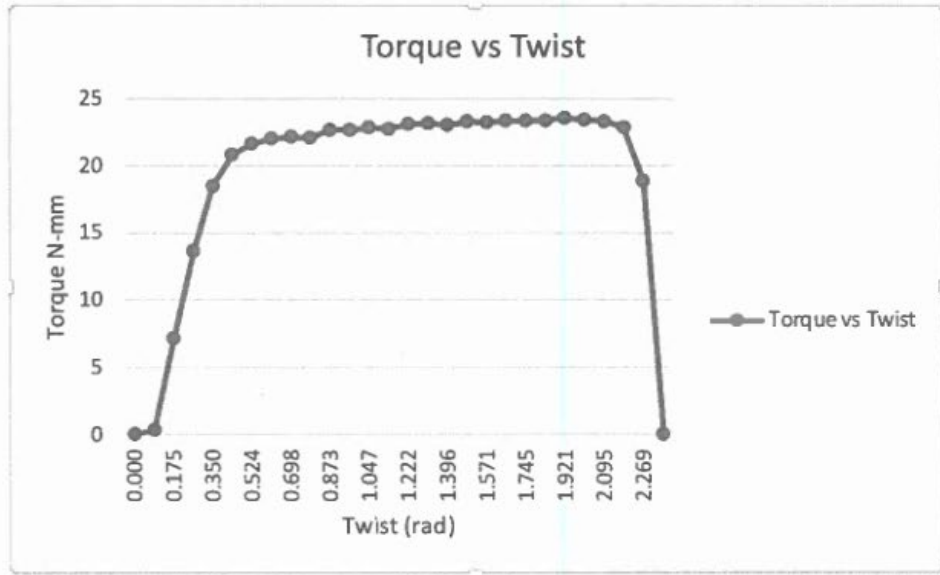
Part b data:

Figure 2

Angle of twist degree	Angle of twist radian	Torque N-mm	Shear stress (Mpa)	Modulus of Rigidity N/mm ²		L (mm)	75
Φ	Φ	T	τ	Pa	0.001	d (mm)	5
0	0.000	0	0	0	Average	r (mm)	2.5
5	0.087	0.34	0.013852846	4.776843533	N/mm ²	J (mm ⁴)	61.35923152
10	0.175	7.12	0.290094898	49.73055392	26.31398427	Pa	
15.08	0.262	13.63	0.55533616	63.5881099			
20.03	0.350	18.45	0.751720627	64.43319662			
25	0.436	20.78	0.846653368	58.25596567			
30	0.524	21.63	0.881285483	50.45527576			
35.01	0.611	22	0.896360639	44.0111607			
40.01	0.698	22.14	0.902064753	38.77069137			
45	0.785	22.07	0.899212696	34.36481641			
50.02	0.873	22.67	0.923658895	31.74085551			
55.2	0.963	22.64	0.922436585	28.73634222			
60.01	1.047	22.83	0.930177882	26.65266137			
65.01	1.135	22.73	0.926103515	24.47850701			
70.01	1.222	23.07	0.939956362	23.07585176			
75.21	1.313	23.12	0.941993545	21.52308175			
80	1.396	23	0.937104305	20.13834466			
85.03	1.484	23.26	0.947697658	19.15830845			
90	1.571	23.2	0.945253038	18.05066272			
95.04	1.659	23.33	0.950549715	17.1889641			
99.99	1.745	23.34	0.950957151	16.34883354			
105.01	1.833	23.37	0.952179461	15.5839519			
110.08	1.921	23.56	0.959920758	14.99095405			
115.02	2.007	23.38	0.952586898	14.23896708			
120.04	2.095	23.3	0.949327405	13.59418718			
125.17	2.185	22.84	0.930585318	12.77691513			
130	2.269	18.8	0.76598091	10.12755721			
135.59	2.366	0	0	0			

Part b graph:

Graph 2



Need Calculation to verify theses values

Test result explanation

In figure 1 and figure 2 a data sheet from excel provides all necessary information and results from the lab. Part a and b have the same calculation process, but the only difference is that for part b a torsion test was used in order to generate the values. The units used for all data is consistent. The units are keeping the angle of twist as radians, torque in N-m, shear stress and modulus of rigidity as N/mm², average of modulus of rigidity as N/mm², and all scales kept as mm. Once all data points are transferred to the excel file, three calculations are conducted in order to get the result of the lab. Which is to find the average modulus of rigidity for each material. The first calculating done is the polar moment of inertia (J). In order to calculate this the only value needed from the scale of the steel material is the radius. Plugging in 15mm as the radius into the equation $(\pi/2) * (15\text{mm})^4$ gives the result as 79521.56 mm⁴. For part b instead of using 15 mm, 2.5mm is inserted. The result of part b's polar moment of inertia is, 61.359 mm⁴. Using the polar moment of inertia, the shear stress can be calculated by using the equation $\tau(L/J)$. For the torque in the calculation use all terms in section E of the excel data and multiply by length (100mm)/ J (79521.56). the polar moment of inertia is to be kept constant as you calculate for each torque. For part b, 75mm is used for length and the J 61.359 mm⁴ is in place of the J. The final two calculations go hand and hand. All information is already calculated in order to find them both. The modulus of rigidity is calculated using the equation $G=(\tau/\theta)*(L/J)$. τ and θ are all values in section B and E. The values in section E are represented as τ and the values in section B are represented as θ . After dividing these two sections, it is multiplied by (L/J). What is multiplied by section B and E, is (L/J). L being 100mm and J being 79521.56. For part b 75 mm is used and for J 61.359mm⁴. Both are to maintain constant throughout the process of calculating. The

calculations in section G are all the values of modulus of rigidity for each value of torque and twist. The final value is the average of all values of modulus of rigidity. Getting the accurate average is done by using the excel function "Average" and highlighting all terms in section G. The average modulus rigidity result is 4.73288 Pa. for part a and for part b the result is 26.3198 Pa.

For both graph 1 and graph 2, both are done using the excel function to graph. These two graphs are torque vs twist. The y value is the torque and the x value is the twist in radians.

Appendix A

Table of contents: Page 2

Appendix B

Abstract: page 3

Appendix C

Introduction: page 3

Appendix: D

Theory: Page 4/5

Appendix D

Test Results: page 4/5

Figure 1

Figure 2

Graph 1

Graph 2

Appendix E

Test result explanation: page 6

Part a average= 4.732886 Pa

Part b modulus of activity average= 26.31398 Pa

Appendix F

Conclusion: Page 14

Appendix G

Resources: page 15

Conclusion

The purpose of this lab is to calculate the modulus of rigidity average for both part a and part b. The modulus rigidity result for part a is 4.73288 Pa. The modulus of rigidity for part b is 26.313 Pa. According to watispiping.com "A high value of modulus of rigidity means it will maintain its shape and a large force will be required to deform it, and a low value of shear modulus signifies the material to be soft or flexible". In conclusion the steel material used in part b is far stronger than the steel material used in plan a.

Need calculations to verify these values

Resources

Dey, Anup Kumar. "Shear Modulus or Modulus of Rigidity (PDF)." *What Is Piping*, What Is Piping, 27 Feb. 2021, <https://whatispiping.com/shear-modulus-or-modulus-of-rigidity/>.

"Torsion Testing." *Torsion Testing - an Overview | ScienceDirect Topics*, <https://www.sciencedirect.com/topics/engineering/torsion-testing>.

Admin. "Shear Modulus (Modulus OF RIGIDITY) - Definition, FORMULA, Units, Examples." *BYJUS*, BYJU'S, 8 Sept. 2020, <https://byjus.com/physics/shear-modulus-elastic-moduli/>.

Hibbeler, R. C. *Mechanics of Materials*. Pearson.

AVERAGE

NO AVERAGE STUDENT WORK SAMPLE FOR LAB #2

BELOW AVERAGE

CVEG 2061

Material and Dynamics Lab Report 2

Fall 2021

Experiment: Torsion Test ✓

Submitted by: Erik Smith ✓

Instructor: Dr. Rada

70 for 100

Due Date: 09-27-2021

Date Submitted: 09-26-2021

Table of Contents

Introduction of Theory.....	page 1
Definitions and significance.....	page 1
Detailed Results.....	page 2
Analysis of Results.....	page 3
Conclusion.....	page 3
References.....	page 3

Introduction of Theory:

For this lab report our topic of focus is the Torsion test. "Torsion is known in engineering as the twisting of a beam or a structural member with torque that rotates on the beams longitudinal axis". The aim of this lab is to conduct torsion test on mild steel. "For transmitting power through a rotating shaft is necessary to apply a turning force. The force is applied tangentially and in the place of transverse cross section. The torque or twisting moment may be calculated by multiplying two opposite turning moments. It is said to be in pure torsion and it will exhibit the tendency of shearing off at every cross section which is perpendicular to the longitudinal axis.

Definitions And Significance:

- Torsion:
 - The twisting of a structural member that is loaded by couples that produce rotation about the member's longitudinal axis. The member is loaded in such a way that the stress resultant is a couple about the longitudinal axis and the response is a twisting motion about the axis.
- Torque:
 - Is a measure of the force that can cause an object to rotate about an axis.
- Modulus of rigidity:
 - Known as the ratio of shear stress to the displacement per unit sample length.
- Shear stress:
 - The amount of force per unit area perpendicular to the axle of the member
- Polar moment of inertia:

- The moment of inertia of the cross-section with respect to the point of intersection of the axis and the plane.

Detailed Results:

Apparatus used:

- A torsion test machine along with angle of twist measuring attachment.
- Standard specimen of mild steel
- Steel rule
- Vernier caliper or a micrometer

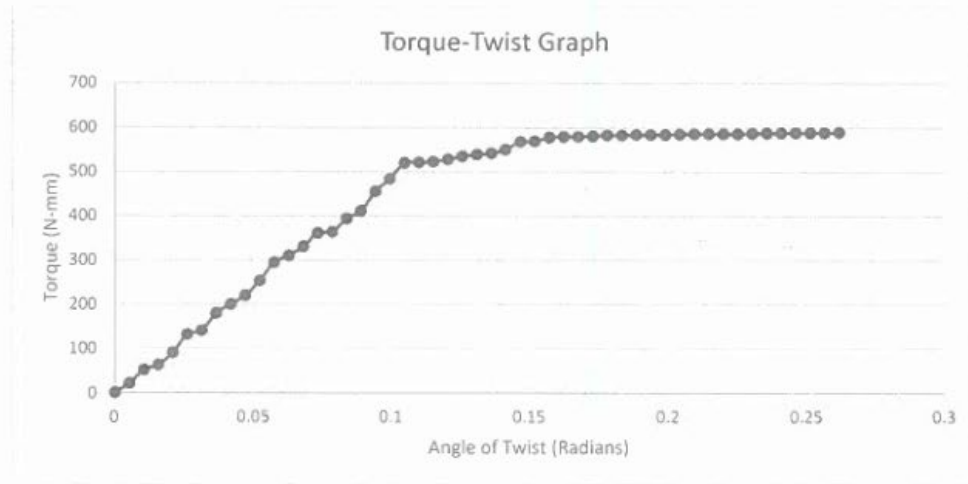
Procedure:

- Select the driving dogs to suit the size of the specimen and clamp it in the machine by adjusting the length of the specimen by means of a sliding spindle.
- Measure the diameter at about three places and take the average value.
- Choose the appropriate range by capacity change lever.
- Set the maximum load pointer to zero.
- Set the protractor to zero for convenience and clamp it by means of knurled screw.
- Carry out straining by rotating the hand wheel in either direction.
- Load the machine in suitable increments.
- Then load out to failure as to cause equal increments of strain reading
- Plot a torque- twist (t- θ) graph.
- Read off co-ordinates of a convenient point from the straight line proportion of the torque twist (t- θ) graph and calculate the value of G by using relation.

Analysis of Results:

From the given results of the lab, this graph shows the relationship of torque to twist of the material tested.

NO data No calculations



Conclusion:

After review and analysis of the lab data, I have come to the conclusion that when conducting a torsion test, the relationship between torque and twist are directly related until the material reaches its limit. And that is when the angle of twist will continue while the torque flattens out. The limit is the point where the material being tested can no longer withstand the strain being put on it due to the torque.

References:

- Torsion test lab handout, that was given out in class

- https://wp.optics.arizona.edu/optomech/wpcontent/uploads/sites/53/2016/10/OPT1_222_W13.pdf
- <https://www.khanacademy.org/science/physics/torque-angular-momentum/torque-tutorial/a/torque>
- https://www.engineeringtoolbox.com/modulus-rigidity-d_946.html
- <https://study.com/academy/lesson/what-is-shear-stress-definition-equation-units.html>
- <https://www.engineersedge.com/polar-moment-inertia.htm>

**MATERIALS & DYNAMICS LAB
FALL 2021**

ASSIGNMENT 4 – Laboratory Assignment #4 - Bending & Deflection Test

TOPICS COVERED IN LABORATORY ASSIGNMENT 4

Laboratory Assignment 4 covered the following topics:

1. Verification of the Bending Equation
2. Flexural Rigidity
3. Elastic Modulus (Young's Modulus)
4. Static Equilibrium on Simply Supported and Cantilever Beams
5. Deflection of Beams on Two Simple Supports with Point Loads

ASSIGNMENT STATEMENT/QUESTIONS
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 4 – Bending & Deflection Test
Given: September 24, 2021
Due October 2, 2021 no later than 11:00 PM

Instructions: Report Due Date: October 2, 2021 before 11: 00 PM. Students will need to create a file as shown below.

file: Last name (space) First name (space) Torsion Lab CVEG 2101

Upload to: CVEG 2101-P81 CANVAS portal under Assignment: Lab Report # 4 - Bending Test

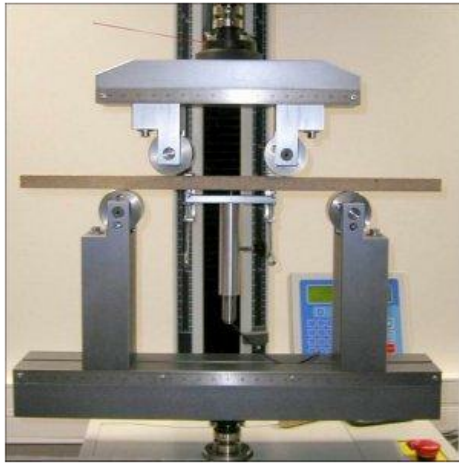
September 24, 2021:

Bending and Deflection Test

Learning outcomes:

- Verification of the bending equation
- Determination of flexural rigidity and elastic modulus (Young's modulus)
- Verification of static equilibrium on simply supported and cantilever beams
- Deflection of beams on two simple supports with point loads

What is a Flexural Test?



Flexure (Bend) tests are generally used to determine the flexural modulus or flexural strength of a material. The material is laid horizontally over two points of contact (lower support span) and

then a force is applied to the top of the material through either one or two points of contact (upper loading span) until the sample fails. The maximum recorded force is the flexural strength of that particular sample.

What is the Purpose of a Flexure Test?

The most common purpose of a flexure test is to measure flexural strength and flexural modulus. Flexural strength is defined as the maximum stress at the outermost fiber on either the compression or tension side of the specimen. Flexural modulus is calculated from the slope of the stress vs. strain deflection curve. These two values can be used to evaluate the sample materials ability to withstand flexure or bending forces.

How to Perform a Flexure Test?

Unlike a compression test or tensile test, a flexure test does not measure fundamental material properties. When a specimen is placed under flexural loading all three fundamental stresses are present: tensile, compressive and shear and so the flexural properties of a specimen are the result of the combined effect of all three stresses as well as (though to a lesser extent) the geometry of the specimen and the rate the load is applied.

What Are the Different Flexure Test Types?

The two most common types of flexure test are three point and four point flexure bending tests. A three point bend test consists of the sample placed horizontally upon two points and the force applied to the top of the sample through a single point so that the sample is bent in the shape of a "V". A four point bend test is roughly the same except that instead of the force applied through a single point on top it is applied through two points so that the sample experiences contact at four different points and is bent more in the shape of a "U". The three point flexure test is ideal for the testing of a specific location of the sample, whereas, the four point flexure test is more suited towards the testing of a large section of the sample, which highlights the defects of the sample better than a 3-point bending test.

A bend test is similar to a flexure test in the type of hardware and test procedure involved. Bend tests are used with ductile materials whereas flexural tests are used with brittle materials.

What Are the Different Types of Flexure Testing Materials?

Generally, a flexure test is run until the sample experiences failure and is therefore ideal for the testing of brittle materials. The most common materials tested in flexure are plastic materials, composites, concrete, and ceramics. Because these materials have a very low ductility they will break before any permanent deformation of the sample occurs allowing for the accurate measurement of the flexural modulus and strength.

Bending Test (General)

The purpose of the bending test is to get an idea of the stiffness (the bending stiffness) of materials. From this simple test, one can determine a reasonable value for the modulus of elasticity.

The materials which may be used for testing in this lab are:

f Steel, 1018

f Aluminum, 6061
f Brass, 360 free machining
f PVC, Type 1

Testing Procedure:

In this test, the specimen will be supported at both ends in a simply supported beam. The supports are placed on rollers. Small weights (lead and steel washers) are used to load the beams and a dial indicator is used to measure the midspan deflection. The load is applied slowly, one weight at a time.

Specimens: The specimens for the bending test are rectangular plates, about 24 in. long, 1-inch wide and about 1/8" thick.

Part a:

For each specimen load will be applied in small increments using the lead disks provided. The load is applied as a concentrated force at the midspan of the beam and the deflection is measured at the same location. Need to record the span of the beam, the weight of each lead disk and the deflection of the beam the load causes.

The idea is to develop a load deflection graph, so need to take a number of measurements. About 7 to 10 loads in increasing order should be enough. Need to measure all the dimensions of beams.

Part b:

Select one of the beams.

i) Turn the beam to stand on its side (thin side down, wide face to the side, and maintain the same span). Use the paperclip to affix a weight to the beam and measure deflection. How does the stiffness of the beam in this orientation compare to that in part a?

ii) Return to the original beam orientation, reduce the span of that beam to 1/2 the span used in part a., and repeat a couple of the measurements. How does the deflection change?

.....
CVEG 2101-P81: MATERIALS AND DYNAMICS LAB

EXPERIMENT 4

**STRESSES, STRAINS AND DEFLECTION OF
STEEL BEAMS OR PLATES IN PURE BENDING**

OBJECTIVE

1. To compare the theoretical strain predictions with the strain measurements obtained from both the electrical and mechanical strain gage methods.
2. To experimentally determine the location of the neutral axis in the beam cross section and compare it with the theoretical predicted value.

3. To examine the validity of the assumption made in the flexural analysis of beams that cross sections remain plane during bending.
4. To compare the theoretically predicted deflections with the measured experimental values.

SPECIMEN

Submitted by _____	Material _____
Group _____ Section _____	Section _____
Date Performed _____	Clear Span _____
Date Submitted _____	
Instructor _____	

THEORY

Consider a simply supported beam under four-point bending which is illustrated in Figure 3-1. If the cross-section of a beam is symmetrical about its neutral axis, the maximum tensile and compressive stresses are equal.

Thus, the flexure formula
$$\sigma_x = -\frac{M_z y}{I_z} = -\frac{My}{I} \quad (3-1)$$

Becomes
$$\sigma_{t(at\ bottom)} = -\sigma_{c(at\ top)} = \frac{Mc}{I} = \frac{M}{S} = \frac{Pa}{S} \quad (3-2)$$

where

- σ_t = the maximum tensile stress
- σ_c = the maximum compressive stress
- S = section modulus = I_z / c
- $M_z = M = Pa$ = bending moment about the z-axis
(with respect to the neutral axis)
- $I_z = I$ = moment of inertia of the cross-section about the z-axis
- c = distance from the neutral axis to the extreme element in y-direction
- a = distance from support to the applied load

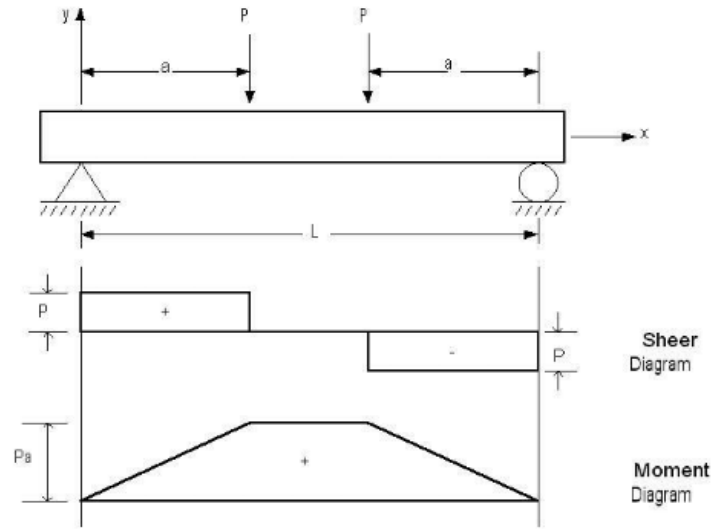


Figure 3-1 A simply supported beam under four-point bending

From the Hooke's law or the theory of linearly elastic analysis, one has

$$\sigma_x = E\epsilon_x \quad (3-3)$$

or

$$\epsilon_{t(at\ bottom)} = -\epsilon_{c(at\ top)} = \frac{Mc}{EI} = \frac{M}{ES} = \frac{Pa}{ES} \quad (3-4)$$

where E = modulus of elasticity or Young's modulus

ϵ_t = the maximum tensile strain

ϵ_c = the maximum compressive strain

$EL_z = EI$ = flexural rigidity

DEFLECTION

Deflection calculations are an important part of structural analysis and design, and the design engineers are normally required to verify that the deflections under service loads are within tolerable limits as specified by the Standard Specifications and Codes.

There are several methods available for the calculation of deflections in structures. They are double integration method, moment-area method, conjugate beam method, and matrix structural analysis method, etc., and can be found in most Strength of Materials and Structural Analysis textbooks. The Double Integration method enables us to determine not only the deflection at any location of the structures but also the deflection profile or elastic curve of the structures.

Figure 3-1 shows a simply supported beam under four-point bending. In the case of a prismatic beam with constant EI, the differential equation of the deflection curve (or the elastic curve) of a beam is as follow:

$$\frac{d^2 y}{dx^2} = \frac{M_z}{EI_z} = \frac{M}{EI} \quad (3-5)$$

where $M_z = M$ = bending moment about the z-axis
 E = Young's modulus or modulus of elasticity
 $I_z = I$ = moment of inertia about the z-axis, and
 $EI_z = EI$ = flexural rigidity

From the bending-moment expression of the beam, and the boundary conditions, one can solve the above governing differential equations and attain the following deflection curve or elastic curve:

$$y = -\frac{Px}{6EI}(3aL - 3a^2 - x^2), \quad y' = -\frac{P}{2EI}(aL - a^2 - x^2) \quad (0 \leq x \leq a) \quad (3-6)$$

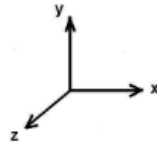
$$y = -\frac{Pa}{6EI}(3Lx - 3x^2 - a^2), \quad y' = -\frac{Pa}{2EI}(L - 2x) \quad (a \leq x \leq L - a) \quad (3-7)$$

$$\delta_c = \delta_{\max} = \frac{Pa}{24EI}(3L^2 - 4a^2) \quad (3-8)$$

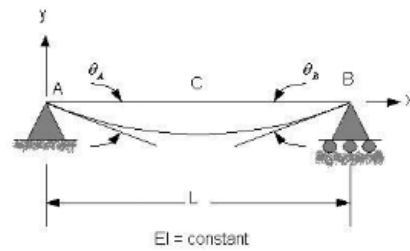
$$\theta_A = \theta_B = \frac{Pa(L - a)}{2EI} \quad (3-9)$$

where

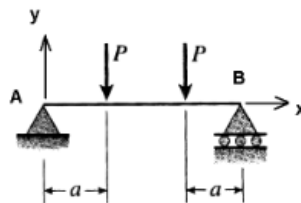
y = deflection in the y-direction (positive upward)
 $y' = dy/dx$ = slope of the deflection curve
 $\delta_c = -y(L/2)$ = deflection at midpoint C of the beam (positive downward)
 $\delta_{\max} = -y_{\max}$ = maximum deflection (positive downward)
 $\theta_A = -y'(0)$ = angle of rotation at left-hand end of the beam (positive clockwise)
 $\theta_B = -y'(L)$ = angle of rotation at right-hand end of the beam
 (positive counterclockwise)



(a) Coordinate System



(b) Deflection curve



(c) Beam with four-point bending

Figure 3-2 A simply supported beam under four-point bending

TEST APPARATUS

The experimental setup is shown in Figure 3-3, which consists of a beam tester and the loads weight 50 lbs each. The instrumentations include the strain indicator and the switching and balancing unit. Also, ten strain gages and eleven sets of mechanical strain gages are installed on one face of the steel beam S8×18.4. The locations are shown in Tables 3-1 and 3-2, respectively.

TABLE 3-1 Electrical Strain Gage at mid-span

Number	Distance from Bottom
1	8.08 inches
2	6.69
3	5.93
4	5.12
5	4.50
6	3.77
7	3.00
8	2.18
9	1.40
10	0.40

TABLE 3-2 Mechanical Strain Gage near mid-span

Number	Distance from Bottom
1	8.21 inches
2	6.77
3	6.05
4	5.37
5	4.71
6	4.04
7	3.37
8	2.67
9	2.03
10	1.39
11	0.47

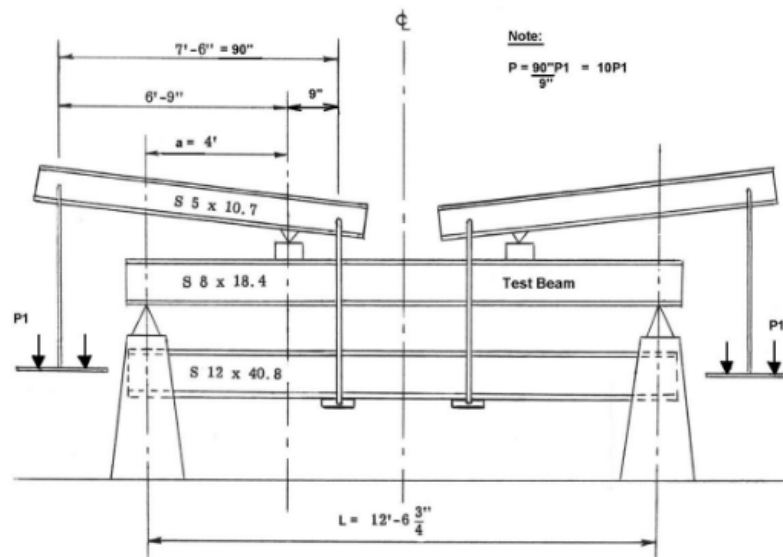


Figure 3-3 Test setup for a simply supported beam S8x18.4 under four-point bending

The mechanical strain gage is commonly used to precisely measure a change in length of less than one-ten thousandth of an inch, and must be handled carefully to prevent damage. To make a reading, the two conical points are inserted into the two gage holes with the axes of the cones perpendicular to the surface on which the measurement is being made, and the instrument is pressed gently against the surface.

The electrical strain gage operates on the principle that, when strained (elongated or contracted), the electrical resistance of a wire changes because of change in length and/or change in cross section. This change in resistance is measured by a Wheatstone Bridge in which the variable resistance has been graduated to read directly in microinches per inch of strain. Each gage consists merely of a very fine wire within a protective covering which has been cemented to the surface of the specimen.

TEST PROCEDURE

1. Use of Measurements Group P-3500 and SB-10 for Strain Measurements

- a) P-3500 Strain Indicator
 - Set Amp Zero to 0
 - Set Gage Factor to 2.015
 - Set Balance to 500
 - Press RUN button to read strain
- b) SB-10 Switch and Balance Unit
 - Adjust gage to a zero reading on the P-3500 by selecting the channel of interest and adjusting the Balance knob on the SB-10 for that channel
 - After loading, measure the strains by selecting the channel of interest and reading the P-3500 display.

2. Use of Demountable Mechanical (DEMMEC) Gage for Strain Measurements

- Set the gage into the 10.0000 inch invar punch bar and zero the gage. The DEMMEC now reads 0 at 10.0000 inches.
- Using the DEMMEC measure the gage lengths at the various levels, the distance between the various gaging points. Deviation +/- from 0.0000 is +/- deviations from 10.0000 inches.
- After loading record readings, The readings are +/- δs . Divide by the gage length to compute the strain.

3. Use of CDI Digital Dial Indicator for Deflection Measurements

- Set the gage reading to zero
- After loading record the deflections

4. Procedure

- a) Zero the electrical gages
- b) Measure the gage lengths
- c) Zero the deflection gage
- d) Apply load to the beam by placing weights onto the loading pans in 200 lbs. increments (the weights are 50 lbs. apiece). With the level arms setup for a load factor of 10, this will produce incremental loads of 2000, 4000 and 6000 lbs. Make

readings of all the electrical and mechanical strain gages, and the deflection gage between each loading and unloading increment.

ANALYSIS OF DATA

1. Based on Equation (3-4), calculate the theoretical unit strain on the top and bottom surfaces of the steel beam for each of the loads P (not $P1$). Note that it is sufficient to determine σ_c and σ_t **only** because only two points are needed to determine the theoretically linear strain distributions across the cross-section.
2. Draw a graph of the theoretical strains for each of the loads, using the beam depth as the ordinate (y-axis) and strain as abscissa (x-axis).
3. On the same graph, show as separate points the measured strains. Indicate which are measured with the electrical strain gage and the mechanical strain gage for each of the loads, i.e., (a) loading, (b) unloading.
4. **Using linear regression analysis, the neutral axis can be obtained by the y-intercept of the regression equations.**
5. From Equation (3-8), calculate the theoretical maximum deflections at mid-span of the beam for each of the loads P (not $P1$).
6. Collect all dial gage readings of the deflection measurements for each of the loads during loading and unloading, and compare their results with the theoretical elastic- deflection values.
7. Compare the experimental deflection measurements with the theoretical values for zero, 2000 lbs. and 4000 lbs. while undergoing loading and unloading.

REPORT

1. Construct a table which compares the theoretical and the experimental maximum tensile strains at the bottom of the beam and the maximum compressive strains at the top as shown in Table 3-3. Discuss the results and findings.

TABLE 3-3 Comparison of theoretical and experimental stresses and strains

Loads, P (lbs)		σ_t (psi) at bottom			σ_c (psi) at top		
		Theoretical	Electrical strain gage	Mechanical strain gage	Theoretical	Electrical strain gage	Mechanical strain gage
Loading	2000						
	4000						
	6000						
Unloading	4000						
	2000						
	0						

Note: the above table is the sample for the stress comparison

2. Plot graphs showing the theoretical strains and the measured strains both by electrical and mechanical strain gages for each of the loads, including loading and unloading. Use the depth of the beam as the y-axis, and the strain as the x- axis of the graphs.
3. Determine and show the locations of the neutral axis in the beam cross section on the graphs for each load. Discuss the results and findings.
4. Discuss and conclude the validity of the assumption that beam cross-sections remain plane during bending.
5. Prepare a table as shown in Table 3-4 which lists all the deflections at mid-span of the test beam determined by Equation (3-8), the theoretical elastic-analysis and by the experimental measurement using the dial gage.

TABLE 3-4 Mid-span deflection

Loads, P (lbs.)		δ_c (inches)		$\delta_{c(exp.)} / \delta_{c(theo.)}$
		Theoretical	Experimental	
Loading	2,000			
	4,000			
	6,000			
Unloading	4,000			
	2,000			
	0			
Average Value				
Standard Deviation				

6. Discuss and conclude the test results and findings such as:
 - (a) Are the dial gage measurements made while loading the steel beam the same as those made while unloading;
 - (b) How do your calculated deflections compare to the actual measured deflections for each of loads? Is the theoretical analysis conservative or does it understate the actual deflection?
 - (c) What are the limitations of the theoretical formulas, Equation (3-5) through Equation (3-9), that are being used in the structural design?

SUGGESTED QUESTIONS

1. Was there good agreement between the theoretical predictions of strain and the experimentally measured strains?
2. Which strain gaging method seems to give the best results?
3. What is your determination of the neutral axis? How did you reach this value?
4. What measurement dictates the precision of the determination of the neutral axis?
5. Was there good agreement between the theoretical predictions of deflections and the measured deflection? Do you believe the expression for deflection is conservative?
6. Were the theories under consideration proved? If so, how? And if not, why?
7. How does the experiment demonstrate that plane sections do indeed remain plane under bending?

EXPERIMENT 4

Strains and Stresses in Pure Bending of Steel Beams

Load P	Electrical Strain Gage Reading (microinches per inch)		Mechanical Strain Gage Reading (in)	
<u>0</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____
			11. _____	
 <u>2,000 lbs</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____
			11. _____	
 <u>4,000 lbs</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____
			11. _____	
 <u>6,000 lbs</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____
			11. _____	

EXPERIMENT 4 (continued)

Load P	Electrical Strain Gage Reading (microinches per inch)		Mechanical Strain Gage Reading (in)	
<u>4000 lbs</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____
				11. _____
<u>2000 lbs</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____
				11. _____
<u>0 lbs</u>	1. _____	6. _____	1. _____	6. _____
Central	2. _____	7. _____	2. _____	7. _____
Deflection	3. _____	8. _____	3. _____	8. _____
(in.)	4. _____	9. _____	4. _____	9. _____
_____	5. _____	10. _____	5. _____	10. _____

- **Collect Data for the following:**

Beam 1:	400 mm	load location and deflection measurement location same
Beam 2	600 mm	load location and deflection measurement location same
Beam 3	800 mm	load and deflection measurement locations Different

- Calculate theoretical deflection for the above cases and compare values with measured values.
- Draw graph with Load versus Theoretical deflection and measured deflection for each case.
- Calculate Maximum bending stress in the cross section at maximum load in each case

REFERENCES

https://www.tec-science.com/material-science/material-testing/bending-flexural-test/#Test_setup
<file:///C:/Users/radha/Downloads/SM1004-Beam-Datasheet.pdf>

<https://www.studocu.com/row/document/the-american-university-in-cairo/strength-and-testing-of-materials/bending-test-lab-report/4392136>

<https://www.med.upenn.edu/pcmd/assets/user-content/documents/Biomechanics/Example1.pdf>

https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-105-solid-mechanics-laboratory-fall-2003/labs/exp6_03.pdf

https://www3.nd.edu/~jott/Solids/Solids_Lab/Lab3/S15_Lab3_3_4_point_bending.pdf

<http://www.mem50212.com/MDME/MEMmods/MEM23061A/Bending/Bending.html>

<http://homepages.wmich.edu/~kujawski/bending%20test.pdf>

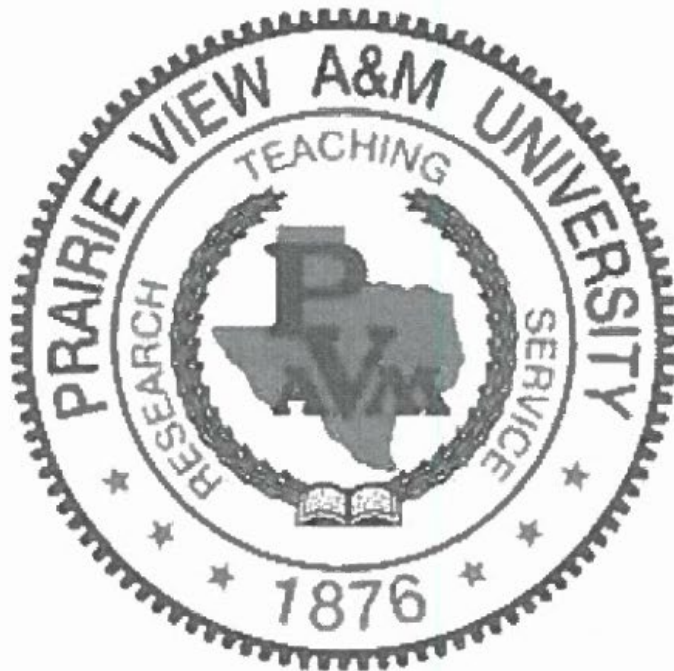
GRADING SCHEME FOR ASSIGNMENT
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 4 – Bending & Deflection Test
Given: September 24, 2021
Due October 2, 2021 no later than 11:00 PM

1. Your lab report should have the following on the cover page
 - a. Your name and roster number
 - b. Course prefix, number, section, and title
 - c. Homework number
 - d. Date given
 - e. Date due
2. Lab report template
 - a. Table of Content
 - b. Abstract
 - c. Introduction
 - d. Theory
 - e. Test Procedure
 - f. Detail Results
 - g. Discussion of Test Results
 - h. Appendices
 - i. References
3. Show all Steps for arriving the final answers
4. Reference all figures, tables, constant values, equation and conversion
5. Show units

Graded by Dr. Radhakrishnan

- Student 1 – Incomplete Introduction, missing table, missing graph for Part A, missing Part B deflection - (Grade 30)
- Student 2 – Incomplete procedure, missing calculation, missing data, incomplete conclusion - (Grade 70)
- Student 3 – Missing calculation, missing data, missing graph - (Grade 75)
- Student 4 – Missing calculation, incomplete conclusion - (Grade 75)
- Student 5 – Missing graph, missing calculation - (Grade 75)

ABOVE AVERAGE



Marshall Johnson ✓

Mechanics of Materials Lab

CVEG 2101 P81

Lab Report 4 – Bending Moment

10/08/2021

See second file (This is File 1 of 2)

75 for 100

Table of Contents

1. Abstract....3
2. Introduction of Bending Moment....4
3. Test Procedure....5
4. Detail Results....6
5. Discussion of the Test Results....7
6. Appendices....8

Abstract

The objective of this lab was to determine the flexural rigidity and elastic modulus (Young's modulus), to verify the static equilibrium on simply supported and cantilever beams, and the deflection of beams on two simple supports with point loads. The data taken from these tests were put into an excel document to show the results of the experiment. Finding the bending moment is an essential skill because it is applicable in multiple instances like structural analysis and mechanics of materials.

Introduction of Theory

Consider a simply supported beam under four-point bending which is illustrated in Figure 3-1. If the cross-section of a beam is symmetrical about its neutral axis, the maximum tensile and compressive stresses are equal.

Thus, the flexure formula
$$\sigma_x = -\frac{M_z y}{I_z} = -\frac{My}{I} \quad (3-1)$$

Becomes
$$\sigma_{t(\text{at bottom})} = -\sigma_{c(\text{at top})} = \frac{Mc}{I} = \frac{M}{S} = \frac{Pa}{S} \quad (3-2)$$

where

σ_t = the maximum tensile stress

σ_c = the maximum compressive stress

S = section modulus = I_z / c

$M_z = M = Pa$ = bending moment about the z-axis
(with respect to the neutral axis)

$I_z = I$ = moment of inertia of the cross-section about the z-axis

c = distance from the neutral axis to the extreme element in y-direction

a = distance from support to the applied load

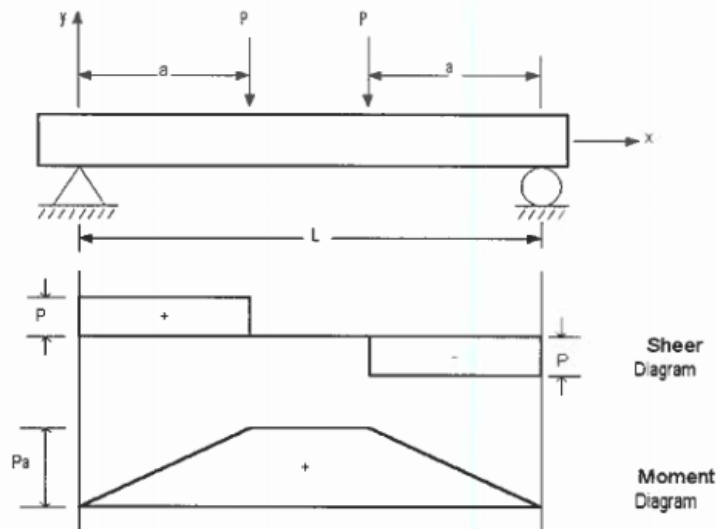


Figure 3-1 A simply supported beam under four-point bending

Test procedure

Part a:

1. For each specimen load will be applied in small increments using the lead disks provided.
2. The load is applied as a concentrated force at the midspan of the beam and the deflection is
3. measured at the same location. Need to record the span of the beam, the weight of
4. each lead disk and the deflection of the beam the load causes.
5. The idea is to develop a load deflection graph, so need to take a number of measurements.
6. About 7 to 10 loads in increasing order should be enough.
7. Need to measure all the dimensions of beams.

Part b:

1. Select one of the beams.
2. Turn the beam to stand on its side (thin side down, wide face to the side, and maintain the same span).
3. Use the paperclip to affix a weight to the beam and measure deflection. How does the stiffness of the beam in this orientation compare to that in part a?
4. Return to the original beam orientation, reduce the span of that beam to $\frac{1}{2}$ the span used in part a., and repeat a couple of the measurements. How does the deflection change?

Detail Results

Where is the data

Discussion of Test Results

In response to this lab, it has been concluded that

????????????????????????????????

Incomplete

Appendices

NONE PROVIDED

See Another file
Next Page

Table 3-1

#	Weight (N)	Deflection (mm)
1	1 N	-0.82
2	1.5	-0.49
3	2	-0.67
4	2.5	-0.82
5	3	-0.99
6	3.5	-1.11
7	4	-1.27
8	4.5	-1.41
9	5	-1.55

Table 3-2

#	Weight (N)	Deflection (mm)
1	1 N	-0.07
2	1.5	-0.09
3	2	-0.1
4	2.5	-0.12
5	3	-0.14
6	3.5	-0.16
7	4	-0.18
8	4.5	-0.2
9	5	-0.22

Table 3-3

(psi) at bottom

Loads		Theoretical	Electric Strain Gage	Mechanical Strain Gagef	Theoretical
Loading	2000				
	4000				
	6000				
	4000				
Unloading	2000				
	0				

-

*

(psi) at top

Electric Strain Gage Mechanical Strain Gagef

Table 3-4

Loads	
	2,000
	4,000
Loading	6,000
	4,000
	2,000
Unloading	0
Average \	
Standard De	

1

2

	(Inches)	Sc(exp)/Sc(theo)
Theoretical	Experimental	

Value
Deviation

AVERAGE

NO AVERAGE STUDENT WORK SAMPLE FOR LAB #4

BELOW AVERAGE

Prairie View A&M University



CVEG 2332: P83

Mechanics of Materials

Section: P83

Lab Report #4 ✓

Due: October 8, 2021

Submitted By: Tamia Ford ✓

Submitted to: Dr. Perkins

30 for 100

Table of Contents

Cover Page	1
Table of Contents	2
Introduction	3
Graph	4
Abstract	5
Appendices	6

Introduction

A **bending moment** exists in a structural element when a moment is applied to the element so that the element bends. Moments and torques are measured as a force multiplied by a distance so they have as unit newton-metres (N·m), or foot-pounds force (ft·lbf). **“The Bending Moment at the ‘cut’ is equal to the algebraic sum of the moments caused by the forces acting to the left or right of the cut.”**

The forces and moments on either side of the section must be equal in order to counteract each other and maintain a state of equilibrium so the same bending moment will result from summing the moments, regardless of which side of the section is selected.

Graph
Bending Moment

Initial Length: 400mm
Height: 20mm
Width: 4mm

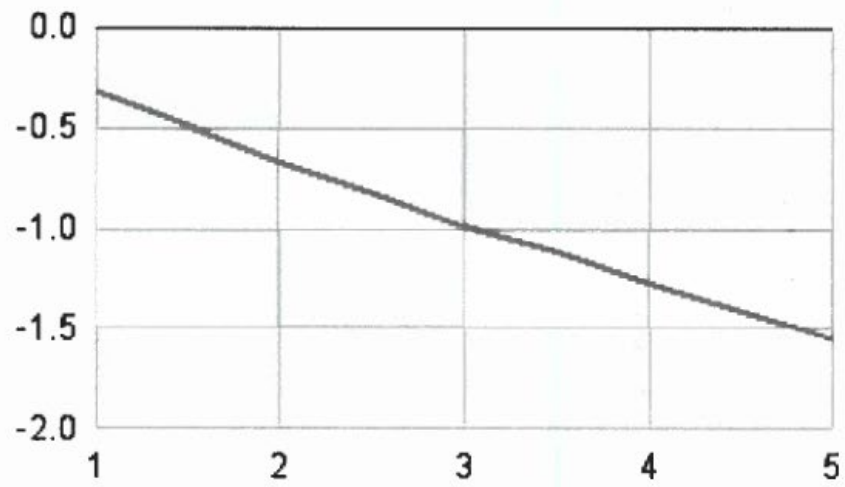
What is this data ?

1	-0.32
1.5	-0.49
2	-0.67
2.5	-0.82
3	-0.99
3.5	-1.11
4	-1.27
4.5	-1.41
5	-1.55

Table has 2 columns

What are the values in column 1 and 2 ?

Abstract



Need to specify what x-axis and y-axis represents.

Appendices

Hibbeler, R. C., and Kai Beng Yap. *Mechanics of Materials*. Pearson, 2018.

<https://dokumen.tips/documents/bending-moment-lab-sheet.html>

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 5 – Laboratory Assignment #5 - Simple Pulleys

TOPICS COVERED IN LABORATORY ASSIGNMENT 5

Laboratory Assignment 5 covered the following topics:

1. Static Equilibrium Through Different Pulley System
2. Effort Force
3. Load Force
4. Tension

ASSIGNMENT STATEMENT/QUESTIONS
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 5 – Simple Pulley
Given: November 5, 2021
Due: November 12, 2021

Instructions: Report Due Date: November 12, 2021, before 10: 00 AM. Students will need to create a file as shown below.

file: Last name (space) First name (space) Simple Pulley CVEG 2101

Upload to: CVEG 2101-P81 CANVAS portal under Assignment: Lab Report # 5 – Simple Pulley

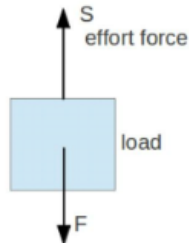
The Pulley Equilibrium

Purpose: To Understand the static equilibrium through different pulley system.

Theory:

A pulley is a device that can increase the magnitude of an effort force.

With no pulley - the effort force is *similar* to the load - in opposite direction.



Equation (1) $S = F$

where

$S = \text{effort force (N, lbs)}$

$F = \text{load (N, lbs)}$

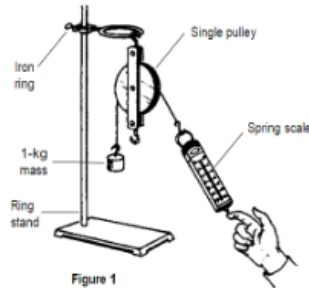
Materials:

Two single axle pulleys, one double axle pulley, spring scale.

Procedures:

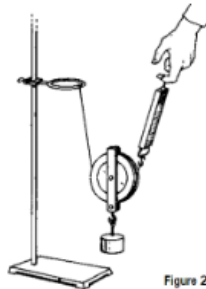
1. Find the weight of the 100g mass by hanging it from the spring scale. Record this weight in the data table as the output force for all of the pulley arrangements.
2. Set up a single fixed pulley similar to Figure 1. Pull down on the spring scale to lift the mass. As you do this, observe the reading on the spring scale. Record this value in the data table as the input force.

Sketch out the diagram, then display a FBD showing the load forces, effort force, and the tension in the string.



3. Set up a single movable pulley, as shown in Figure 2. Lift the mass by pulling up on the spring scale. As you do this, observe the reading on the spring scale. Record this value in the data table as the input force.

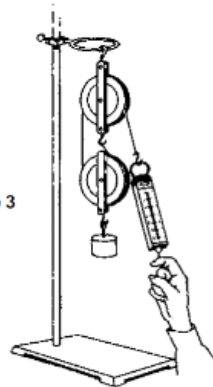
Sketch out the diagram, then display a FBD showing the load forces, effort force, and the tension in the string.



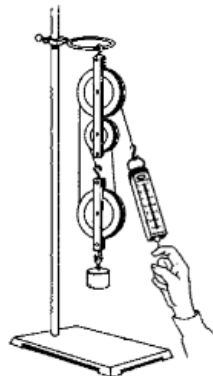
4. Set up the pulley systems, as shown in Figure 3. For each pulley system, observe the reading on the spring scale as you pull it to lift the mass. Record the value in the data table as the input force for the pulley system.

Sketch out the diagram, then display a FBD showing the load forces, effort force, and the tension in the string

Figure 3



Single Fixed Pulley and
Single Movable Pulley



Double Fixed Pulley and
Single Movable Pulley

Table for Data Collection:

Pulleys	Output Force (Newtons)	Input Force (Newtons)
Single Fixed		
Single Movable		
Single Fixed and Single Movable		
Double Fixed and Single Movable		

Discussion

1. Analyzing Data: As you added pulleys to the system, what happened to the amount of effort force needed to raise the mass?
2. Analyzing Data: What type of pulley produced an output force equal in size to the input force?

Conclusion:

Give the efficiency for each trial. Tell what happens to the efficiency when you add more pulleys.

Lab Report Format

1. Your lab report should have the following on the cover page
 - Your First and Last Name
 - Course prefix, number, section, and title
 - Laboratory Title
 - Date Given
 - Date Due
2. Table of Contents
 - Introduction
 - Theory
 - Test Procedures

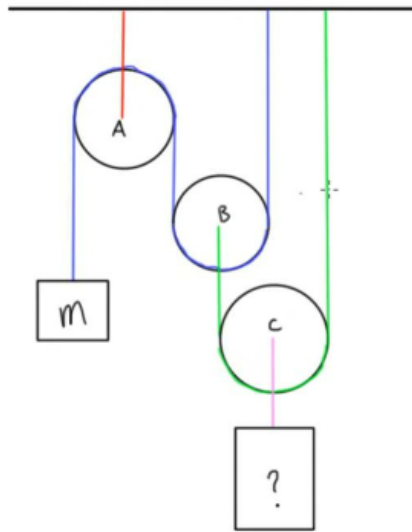
- Detail Results
- Discussion of Test Results
- References
- Appendices
 - Diagram of all 4 trials
 - Data Collection Table
 - Sample Calculations

Bonus Problem

Box m weight = 40kg

What is the total Force of the Second box in order for the pulley system to be in static equilibrium?

Show your FBD to get full credit.



GRADING SCHEME FOR ASSIGNMENT
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 5 – Simple Pulley
Given: November 5, 2021
Due: November 12, 2021

Pulley Lab Report Format Rubric

1. Your lab report should have the following on the cover page

1pt · Your First and Last Name

1pt · Course prefix, number, section, and title

1pt · Laboratory Title

1pt · Date Given

1pt · Date Due

5pt · Table of Contents

10 pt· Introduction

10pt · Theory

10pt· Test Procedures

10pt· Detail Results

10pt· Discussion of Test Results

5pt· References

5pt· Appendices

15pt o Diagram of all 4 trials

10pt o Data Collection Table

5pt o Sample Calculations

Bonus 10 pt

ABOVE AVERAGE



94.75

Omar Hajo

CVEG 2101-17611-P81

Lab Report #5 Simple Pully

Given: November 5, 2021

Due: November 12, 2021

Missing Course
Title

- 0.25

TABLE OF CONTENTS

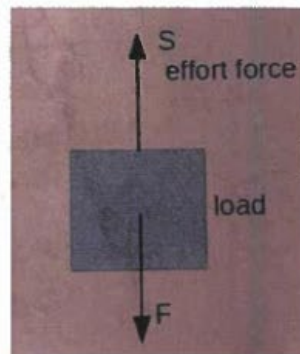
INTRODUCTION	3
THEORY	3
TEST PROCEDURES	4-6
DETAILED RESULTS	6
DISCUSSION OF TEST RESULTS	6-7
REFERENCES	8
APPENDICES	9

Introduction

The purpose of the lab is to deal with several types of simple pulley and finding the output and input forces at different fixed single and double points. The first evidence of a pulley according to newworldencyclopedia.org "dates back to Ancient Egypt in the Twelfth Dynasty (1991-1802 B.C.E.), although these were probably not used to gain mechanical advantage but rather to change the direction of the pull". The following lab will consist of single fixed, single movable, single fixed and single movable, and double fixed and single movable pulleys.

Theory

The theory behind the simple pulley is so that one can experiment adding different forces that will increase or decrease the value of the magnitude.



Equation

$$S = F$$

S = Effort force (N, lbs)

F = Load (N, lbs)

Test Procedure

- Use a mass that weighs 5 N
- Use spring scale
- Two single axle pulleys
- One double axle pulley
- Fill in data charts below
- Use pulleys as each figure below represents

Data chart 1:

Pulleys	Output Force	Input Force
Single Fixed		
Single Movable		
Single Fixed and Single Movable		
Double Fixed and Single Movable		

Figure 1: Single Fixed Pulley

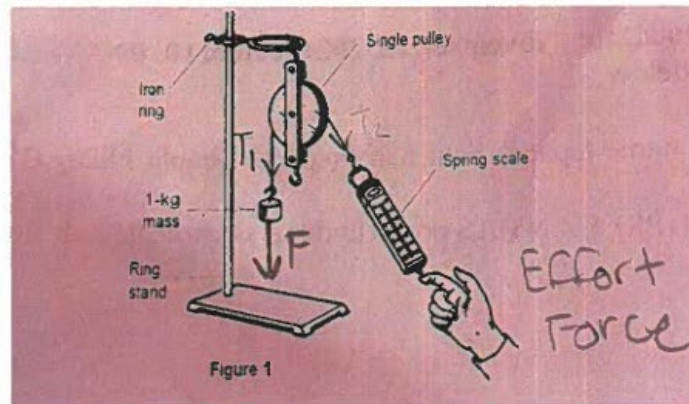


Figure 2: Single movable pulley

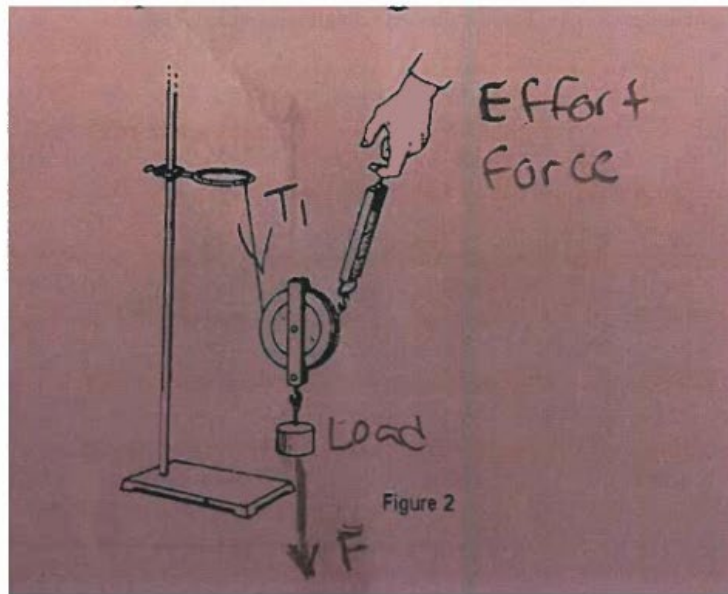
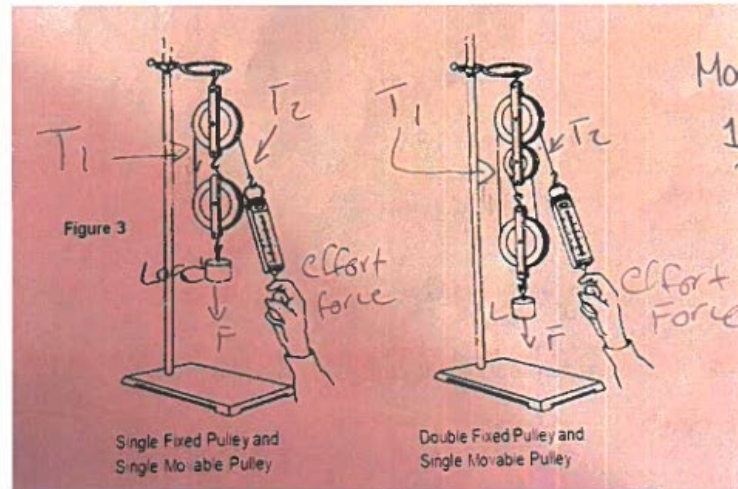


Figure 3 left image: Single Fixed Pulley and Single Movable Pulley

Figure 4 Right image: Double Fixed Pulley and Single Movable Pulley



Detailed Results

Pulleys	Output Force	Input Force
Single Fixed	5	5
Single Movable	5	2.5
Single Fixed and Single Movable	5	2
Double Fixed and Single Movable	5	1.5

Discussion of Test Results

1. As you added pulleys to the system, what happened to the amount of effort force needed to raise the mass?

Analyzing the data points listed in the table under detailed results clearly shows that the input force decreases as we go from a single pulley to a double pulley

2. What type of pulley produced an output force equal in size to the input force?

The only experiment that gave the same input and output force was the single pulley we conducted.

In conclusion each trial had its own level of efficiency starting from the single pulleys to the double pulleys. Dealing with a single fixed pulley we need to put more force to lift the 5N mass we added to the experiment. The single movable pulley needed half the input force of the fixed pulley being that pulley could move it gave room for the mass to be lifted with ease. For single and fixed and single movable pulleys it required only 2N to lift the mass and lastly the double fixed and single movable pulley turned out to be the most efficient out of all 4 experiments. The reason being is that it only called for 1.5N of input force, which means the pulley assisted the individual to ease the work needed to lift the load. To conclude, in the data table listed in the "Detailed Results" it goes in order from less efficient to most efficient.

- Spt
Sample Calculation

Reference

"Pulley." *Pulley - New World Encyclopedia*,
<https://www.newworldencyclopedia.org/entry/Pulley>.

Appendices

Appendix A

Introduction: Page 3

Appendix B

Theory: page 3

Appendix C

Test Procedure: Page 4-6

Appendix: D

Detailed Results: Page 6

lastly the double fixed and single movable pulley turned out to be the most efficient out of all 4 experiments. The reason being is that it only called for 1.5N of input force, which means the pulley assisted the individual to ease the work needed to lift the load.

Appendix: E

Discussion of Test Results: Page 6-7

Appendix: F

Reference: Page 8

AVERAGE



85

Marshall Johnson

Mechanics of Materials Lab

CVEG 2101 P81

Lab Report 5 – Simple Pulley

Given: November 5, 2021

Due: November 11, 2021

Table of Contents

1. Introduction....3
2. Theory....4
3. Test Procedure....5
4. Detail Results....6
5. Discussion of the Test Results....7
6. References....8
7. Appendices....9

Introduction

The objective of this lab is to understand more about pulleys and how static equilibrium plays into it.

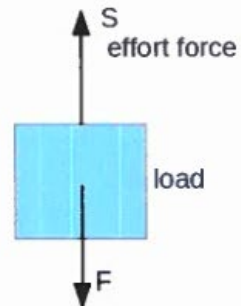
Theory

A pulley is a device that can increase the magnitude of an effort force. With no pulley, the effort force is similar to the load in the opposite direction.

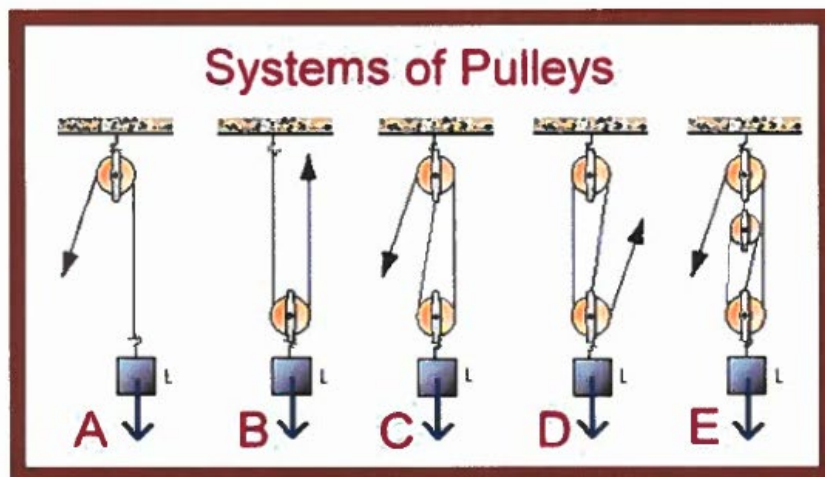
Formulas used: $S=F$

S = effort force (N, lbs)

F = load (N, lbs)



The Engineering ToolBox
www.EngineeringToolBox.com



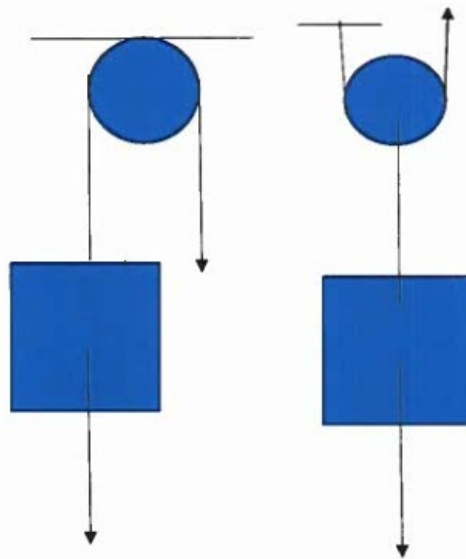
Test Procedures

1. Find the weight of the 100g mass by hanging it from the spring scale.
Record this weight in the data table as the output force for all of the pulley.
2. Set up single fixed pulley
 - a. Pull down on spring and observe reading on spring scale
 - b. Record value
 - c. Sketch corresponding FBD
3. Set up single moveable pulley
 - a. Pull up on spring and observe reading on spring scale
 - b. Record value
 - c. Sketch corresponding FBD
4. Set up single fixed pulley and single moveable pulley
 - a. Pull down on spring and observe reading on spring scale
 - b. Record value
 - c. Sketch corresponding FBD
5. Set up double fixed pulley and single moveable pulley
 - a. Pull down on spring and observe reading on spring scale
 - b. Record value
 - c. Sketch corresponding FBD

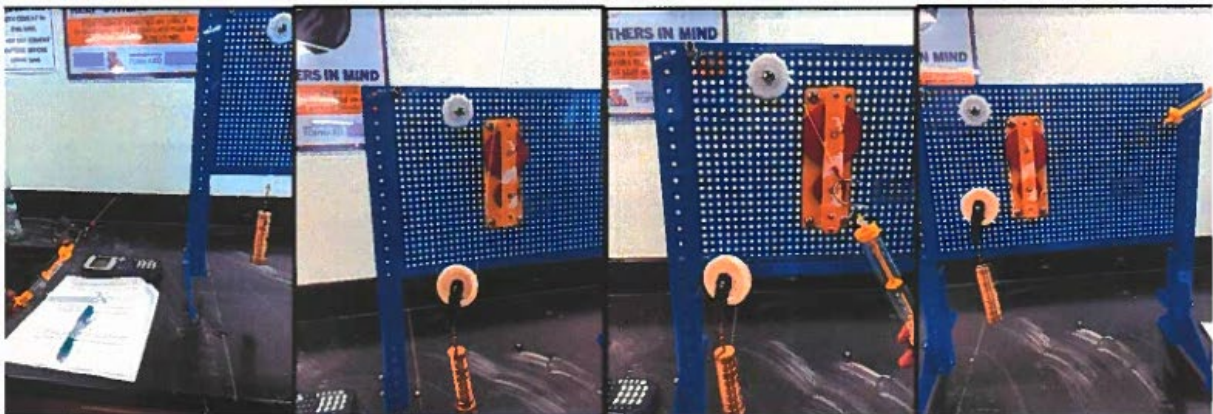
Detail Results

In response to the lab, I can say that the result has successfully been executed. As the number of pulleys increase, so does the efficiency of the machine.

Below, I have completed FBDs for each pulley type in this lab:



-10pt Not Completed
FBD
Missing Labels,
Load Force, Effort force,
& tension



Discussion of Test Results

After analyzing the data, the following questions were asked:

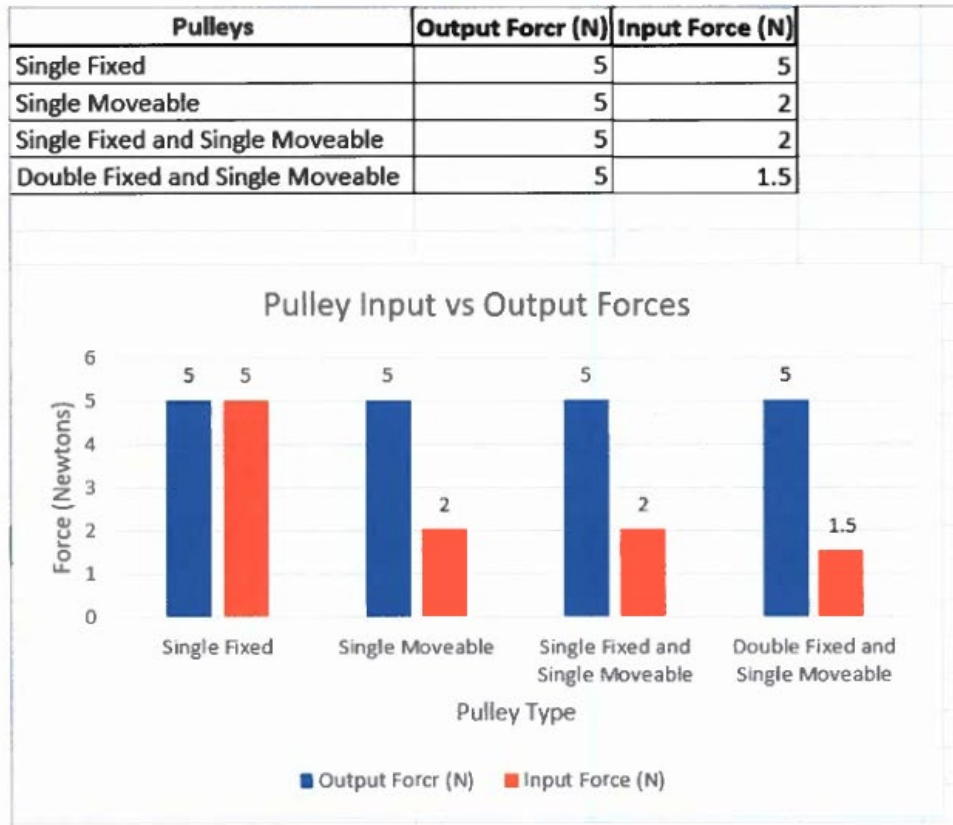
1. As pulleys were added to the system, what happened to the amount of effort needed to raise the mass?
 - a. The amount of effort needed got smaller and smaller.
2. What type of pulley produced an output force equal in size to the input force?
 - a. The single fixed pulley had an equal input and output force.

References

All references were taken from the lab packet as well as the lab instructor.

- 5pt Sample Calculation

Appendices



BELOW AVERAGE

**CIVIL ENGINEERING DEPARTMENT
PRAIRIE VIEW A&M UNIVERSITY**



59

CVEG 3063 HYDRAULICS LABORATORY

-1 pt
Wrong Course

FALL 2021

LABORATORY REPORT ON

Lab 5 - The Pulley Equilibrium

Conducted on

November 5, 2021

Submitted by

RYAN O LOGWOOD JR

On

November 12, 2021

To

Dr. Perkins

-5pt Missing Table of Content

Objectives:

The objective of this lab was to understand the mechanics behind a pulley system using a real-life situation. In this case, a single-fixed pulley, a single moveable pulley, a conglomeration of the two, and a double fixed conglomeration would be used to test said mechanics. Concretely, how the different pulleys increase or decrease the input forces applied to them.

Introduction and Overview:

As previously exclaimed, pulley systems effect the input forces applied to them. In theory, when a load is applied to a pulley system, the effort force should subsequently result in equilibrium. Likewise, the effort force applied to a pulley system should always make up for the load applied to the pulley system.

For this experiment, groups would be split into two understand the functions of a pulley system more directly – rather than indirectly, as a large group. One member would apply the input forces and effort forces to the pulley, while the other member would make sure accuracy was consistent in the experiment. This would mean static objects (no pulley system is swinging while findings are made), and comparing readings amongst one another. This would be done for the single moveable pulley, single fixed & moveable pulley, and double moveable pulley as well.

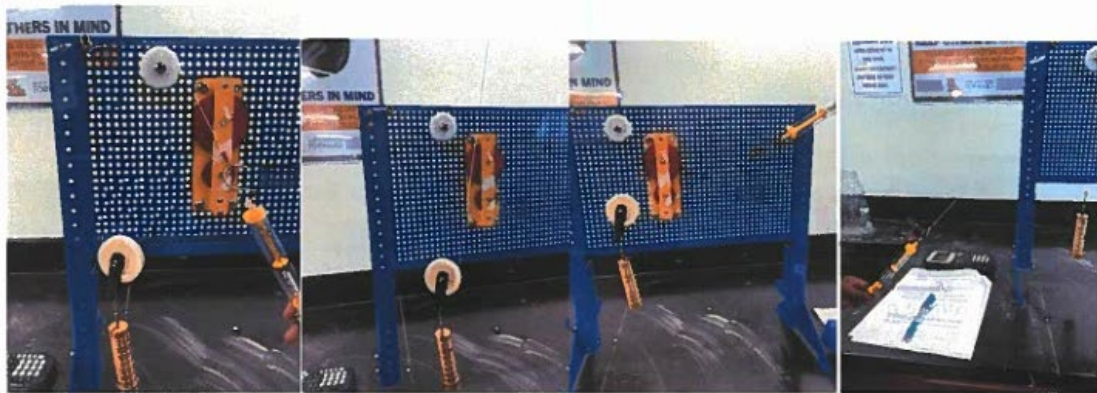
-10pt Missing Theory

Procedure:

The procedure of the lab is to find the weight of the mass applied to the pulley systems. In this case, 100 kg masses were consistently used across the different pulley systems provided. Hanging said weight from a spring scale, the data collected was to be recorded. Once hanging, the spring scale is to be pulled down in order to lift the mass loaded onto the pulley. Once the

mass begins to be lifted, the output force of the pulley is to be recorded. This would be done for all four pulleys provided (single fixed, single moveable, single fixed & moveable, and double fixed & moveable pulleys).

Data Presentation: Shown below is the setup for the single fixed pulley (left), single moveable pulley, single fixed & single moveable pulley, and double fixed & single moveable pulley (right), respectively.



Below is calculations taken by my group member, and I, respectively.

Pulleys	Output Force (N)	Input Force (Newtons)
Single Fixed	5	5
Single Movable	5	2
Single Fixed and Single Movable	5	2

Double Fixed and Single Movable	5	1.5
---------------------------------	---	-----

Sources of Error:

Sources of error that may have been applicable to our experiment may have been the pendulum potentially swinging while taking calculations. Also, estimations made by group members may differ from what may have been seen by other group members.

Conclusion:

In conclusion, output forces are constant in pulley findings, while input forces may differ. Input and output forces in single fixed pulleys appear to be most directly with each other. Single moveable pulleys, along with single fixed & moveable pulleys, appear to be equal in input force. This occurs because of the 1:1 ratio that single fixed pulleys have in input & output forces. Nonetheless, it is the moveable pulley mechanics that decrease the input force needed to raise the mass. Conclusively, an increase in pulleys added to a system result in a decrease in the input force needed, making this an indirect relationship.

List of References (Bibliography):

Hibbeler, R. C., Fan, S. C., Schiavone, P., Hibbeler, R. C., & Hibbeler, R. C. (2007). Chapter 16 - Planar Kinetics of a Rigid Body. In Engineering mechanics: Statics - dynamics. essay, Prentice Hall/Pearson Education.

-15 pt Missing FBD
 - 5pt Missing Sample Calculation
 - 5pt Appendix

**MATERIALS & DYNAMICS LAB
FALL 2021**

ASSIGNMENT 6 – Laboratory Assignment #6 - Simple Pendulum

TOPICS COVERED IN LABORATORY ASSIGNMENT 6

Laboratory Assignment 6 covered the following topics:

1. Newton's Second Law for Rotational Systems
2. Periods of a Simple Pendulum
3. Length of the Pendulum
4. Angle of Initial Dislocation

ASSIGNMENT STATEMENT/QUESTIONS
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 6 – Simple Pendulum
Given: November 5, 2021
Due: November 12, 2021

Instructions: Report Due Date: November 12, 2021 before 10: 00 AM. Students will need to create a file as shown below.

file: Last name (space) First name (space) Simple Pendulum CVEG 2101

Upload to: CVEG 2101-P81 CANVAS portal under Assignment: Lab Report # 6 – Simple Pendulum

The Simple Pendulum

In this laboratory, you will investigate the effects of a few different physical variables on the period of a simple pendulum. The variables we consider are the length of the pendulum and angle of initial dislocation.

There will be a pendulum simulation (https://phet.colorado.edu/sims/html/pendulum-lab/latest/pendulum-lab_en.html). For each situation, you will make three measurements of the period (T). This will allow you to produce graphs which will aid you in determining the dependence of the period on the variable being tested, or even whether there is a dependence on this variable within your experimental error.

Theory

A simple pendulum consists of a mass m hanging from a string of length L and fixed at a pivot point (P). When displaced to an initial angle and released, the pendulum will swing back and forth with periodic motion. By applying Newton's second law for rotational systems, the equation of motion for the pendulum may be obtained

$$\tau = I\alpha \Rightarrow -mgL \sin\theta = mL \frac{d^2\theta}{dt^2},$$

and rearranged as

$$\frac{d^2\theta}{dt^2} + \frac{g}{L} \sin\theta = 0.$$

If the amplitude of angular displacement is small enough that the small angle approximation ($\sin\theta \approx \theta$) holds true, then the equation of motion reduces to the equation of simple harmonic motion

$$\frac{d^2\theta}{dt^2} + \frac{g}{L} \theta = 0.$$

The simple harmonic solution is

$$\theta(t) = \theta_0 \cos(\omega t + \phi)$$

with $\omega = \sqrt{g/L}$ being the natural frequency of the motion.

The period for a simple pendulum does not depend on the mass or the initial angular displacement, but depends only on the length L of the string and the value of the gravitational field strength g , according to

$$T = 2\pi \sqrt{\frac{L}{g}}$$

When the angular displacement amplitude of the pendulum is large enough that the small angle approximation no longer holds, then the equation of motion must remain in its nonlinear form

$$\frac{d^2\theta}{dt^2} + \frac{g}{L} \sin\theta = 0$$

This differential equation does not have a closed form solution and must be solved numerically.

Part 1. Length Dependence

1. Use angles between 10 to 45 degrees, for each trial. You can minimize your data collection tasks by using some of the data previously used.
2. Set the angle of the pendulum and mass will be set to 1-kg.
3. In the Pendulum Simulation, vary the length of the pendulum. It is easiest to do this by changing the length in the Simulation under Length #1.
4. Calculate the period of the oscillations for each length by dividing the total time by the number of oscillations, which is 20. Record the values in the appropriate column of your data table.
5. Perform three trials with different lengths, and then record your data. In addition, show the percentage error between the periods (T) calculated in respect to the theoretical period (T).

Table for Data Collection: Length Dependence

	Trial 1	Trial 2	Trial 3
Length in meters			
Square feet (L)			
Period (T)			
Average			
%Error			

Part 2. Angle Dependence

1. Use the Simulator, measure T (as in previous parts of the procedure, three trials for each angle) for three different starting angles. Use angles between 5 degrees and 80 degrees.

Table for Data Collection: Angle Dependence

Parameters	Trial 1	Trial 2	Trial 3
Angle (θ)			
Period (T)			
Average			
%Error			

Data Analysis and Questions

Plot the data from Part 1 as T vs L . Also, plot the data from Part 1 as T vs $\sqrt{L}$ and attempt to draw a “best-fit” straight line for both.

- Which appears to be a better straight line?
- Which appears to be more consistent with the data points? (i.e., most closely passes through all points.)
- For which graph can you expect a straight line?
- What should the slope of that line be?

Plot the data from Part 2 as T vs $\sin(\theta)$.

- Can you discern a relationship between T and θ ?
- Should T depend upon θ ?

Lab Report Format:

1. Your lab report should have the following on the cover page
 - Your First and Last Name
 - Course prefix, number, section, and title
 - Laboratory Title
 - Date Given
 - Date Due
2. Table of Contents
 - Introduction
 - Theory
 - Test Procedures
 - Detail Results
 - Discussion of Test Results
 - References
 - Appendices
 - Graphs from Excel Spreadsheets
 - Data Collection Table
 - Sample Calculations

GRADING SCHEME FOR ASSIGNMENT
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 6 – Simple Pendulum
Given: November 5, 2021
Due: November 12, 2021

Pendulum Lab Report Format Rubric

1. Your lab report should have the following on the cover page

1pt · Your First and Last Name

1pt · Course prefix, number, section, and title

1pt · Laboratory Title

1pt · Date Given

1pt · Date Due

5pt · Table of Contents

10 pt · Introduction

10 pt · Theory

10 pt · Test Procedures

10 pt · Detail Results

10 pt · Discussion of Test Results

5 pt · References

5 pt · Appendices

15pt o Graphs from Excel Spreadsheets

5pt o Data Collection Table

10pt o Sample Calculations

ABOVE AVERAGE



94.75

Omar Hajo

CVEG 2101-17611-P81

Lab Report #6 Simple Pendulum

Given: November 5, 2021

Due: November 12, 2021

-0.25
Course Name

TABLE OF CONTENTS

INTRODUCTION	3
THEORY	3
TEST PROCEDURES	3-4
DETAILED RESULTS	5-8
DISCUSSION OF TEST RESULTS	8
REFERENCES	9
APPENDICES	10-11

Introduction

The pendulum brings significance in so many ways besides the satisfaction of watching it tick back and forth. According to sciencing.com one of the first recognitions of the pendulum was done by scientist known as Zhang Heng. The pendulum he created acted as a lever due to the damage caused by an earthquake. Unlike Zhang Heng using the pendulum to compromise with a calamity, in this lab we used a pendulum simulator to conduct the different periods when changing the degree and length at which the pendulum moves.

Theory

The simple pendulum is a simple design that has a significant outcome when wanting to conduct experiments. The design is simple, it's a mass that connects to a hanging string at a designated length. At any given experiment one can choose the degree at which they would like to release the pendulum causing a periodic motion. Obtaining the equation to find the motion in the pendulum is done by using Newtons second law.

Period equation: $2\pi\sqrt{L/g}$

%error: $\frac{Expected - Actual}{Expected} * 100$

Test Procedures

Part 1

1. Use online simple pendulum simulator
2. Chose the length for each trial
3. Set timer and divide the time it takes to complete 20 sets by 20 to find the period for all three angles
4. Each 3 trials need to have different lengths for each test
5. Sqrt each length for each trial

6. Calculate the average of all three periods
7. Calculate the % error using the theoretical period and actual period
8. Graph period vs length
9. Also graph period sqrt

	Trail 1	Trail 2	Trail 3
length			
square feet			
period			
average			
%Error			

Part 2

1. Use same online simulator
2. Choose an different angle between 10-45 for each trial
3. Set timer and divide the time it takes to complete 20 sets by 20 to find the period for all three angles
4. Calculate the average of all three periods
5. Graph period vs $\sin(\text{angle})$

What length did you use?

Parameters	Trial 1	Trial 2	Trial 3
angle			
sin angle rad			
period			
average			
%Error			

Detail Results

Part 1

	Trial 1	Trial 2	Trial 3
length	0.6	0.7	0.8
square feet	0.36	0.49	0.64
period	1.613	1.75	1.8645
average	1.74		
%Error	36.75	34.22	31.99

Expected $T = 2\pi \left(\frac{L}{g} \right)$

Period 1 (30.26s / 20) = 1.613

Period 2 (35s / 20) = 1.75

Period 3 (37.29s / 20) = 1.8645

Average = 1.613 + 1.75 + 1.8645 = 1.74

% Error 1 = $2\pi\sqrt{(1.613/9.88)} = 2.55$ 1.55

$(2.55 - 1.613) / 2.55 * 100 = 36.75\%$
 $-0.04 * 100 = 4\%$

% Error 2 = $2\pi\sqrt{(1.75/9.88)} = 2.65$ 1.67

$(2.65 - 1.75) / 2.65 * 100 = 34.22\%$ 4.79%

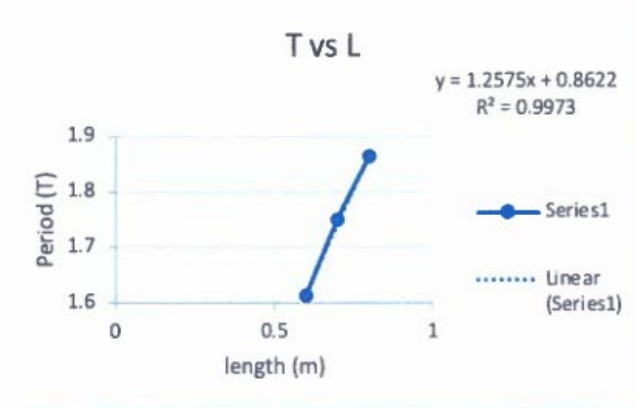
% Error 3 = $2\pi\sqrt{(1.8645/9.88)} = 2.741$ 1.79

$(2.741 - 1.8645) / 2.741 * 100 = 31.99\%$ 4.16%

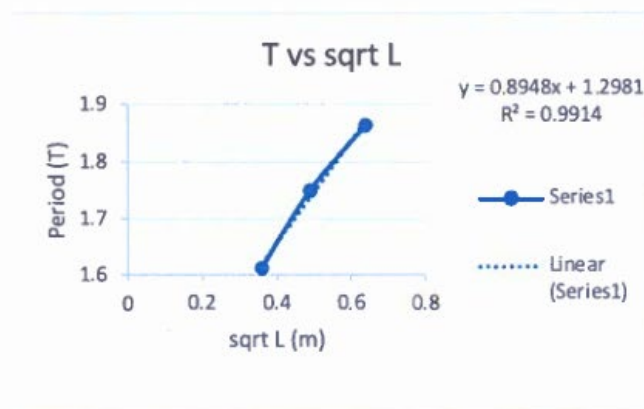
-5pt

Sample Calculation
Errans.

Graph 1



Graph 2



Part 2

Parameters	Trial 1	Trail 2	Trail 3
✓ angle	25	35	45
✓ sin angle rad	0.422	0.574	0.71
✓ period	1.5725	1.5815	1.62
✓ average	1.591		
%Error	37.59	37.69	38.33

What Length was use?

Expected $T = 2\pi \sqrt{\frac{L}{g}}$

$\sin(25^\circ) = 0.422$

$\sin(35^\circ) = 0.574$

$\sin(45^\circ) = 0.71$

Period 1 (31.45s / 20) = 1.5725

Period 2 (31.63s / 20) = 1.5815

Period 3 (32.4s / 20) = 1.62

Average = 1.5725 + 1.5815 + 1.62 = 1.591

~~% Error 1 = $2\pi \sqrt{(1.5725/9.8) = 2.52}$~~

~~$(2.52 - 1.5725) / 2.52 * 100 = 37.59\%$~~

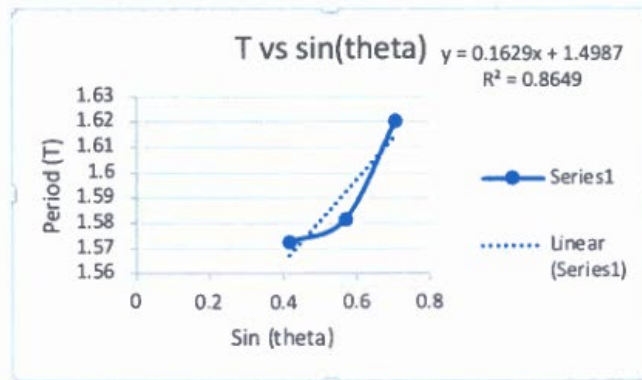
~~% Error 2 = $2\pi \sqrt{(1.5815/9.8) = 2.524}$~~

~~$(2.524 - 1.5815) / 2.524 * 100 = 37.69\%$~~

~~% Error 3 = $2\pi \sqrt{(1.62/9.8) = 2.58}$~~

~~$(2.55 - 1.62) / 2.55 * 100 = 38.33\%$~~

Graph 1



Discussion of test Results

Part 1

1. Which appears to be a better straight line? **The graph the resulted in a straighter line is graph 1 from part 1,**
2. Which appears to be more consistent with the data points? **The graph T vs L appears to be more consistent with the data points**
3. What should the slope of that line be? **The slope of graph 1 is 1.2575**

Part 2

1. Can you discern a relationship between T and θ ? **The relationship between the period and the angle is that the greater the angle the longer the period becomes throughout all three trials**
2. Should T depend upon θ ? **Yes, the period does depend on the angle, due to the change in angle increasing or decreasing the period will also increase or decrease**

Reference

Taylor, Stacy. "History of the Pendulum." *Sciencing*, 2 Mar. 2019, <https://sciencing.com/history-pendulum-4965313.html>.

Appendices

Appendix A

Introduction: Page 3

Appendix B

Theory: page 3

Appendix C

Test Procedure: Page 3-4

Appendix: D

Detailed Results: Page 5-8

Part 1: Period 1 (30.26s / 20) = 1.613

Period 2 (35s / 20) = 1.75

Period 3 (37.29s / 20) = 1.8645

Average = 1.613 + 1.75 + 1.8645 = 1.74

% Error 1 = $2\pi\sqrt{1.613/9.88} = 2.55$

$(2.55 - 1.613) / 2.58 * 100 = 36.75 \%$

% Error 2 = $2\pi\sqrt{1.75/9.88} = 2.65$

$(2.65 - 1.75) / 2.65 * 100 = 34.22 \%$

% Error 3 = $2\pi\sqrt{1.8645/9.88} = 2.58$

$$(2.741-1.8645)/2.58 * 100 = \mathbf{31.99 \%}$$

$$\text{Part 2: Sin}(25^\circ) = 0.422$$

$$\text{Sin}(35^\circ) = 0.574$$

$$\text{Sin}(45^\circ) = 0.71$$

$$\text{Period 1 } (31.45\text{s} / 20) = \mathbf{1.5725}$$

$$\text{Period 2 } (31.63\text{s} / 20) = \mathbf{1.5815}$$

$$\text{Period 3 } (32.4\text{s} / 20) = \mathbf{1.62}$$

$$\text{Average} = 1.5725 + 1.5815 + 1.62 = \mathbf{1.591}$$

$$\% \text{ Error 1} = 2\pi\sqrt{(1.5725/9.8)} = 2.52$$

$$(2.52-1.5725)/2.52 * 100 = \mathbf{37.59 \%}$$

$$\% \text{ Error 2} = 2\pi\sqrt{(1.5815/9.8)} = 2.524$$

$$(2.524-1.5815)/2.524 * 100 = \mathbf{37.69 \%}$$

$$\% \text{ Error 3} = 2\pi\sqrt{(1.62/9.8)} = 2.58$$

$$(2.55-1.62)/2.55 * 100 = \mathbf{38.33 \%}$$

Appendix: E

Discussion of Test Results: Page 8

Appendix: F

Reference: Page 9

AVERAGE

Prairie View A&M University



77.75

CVEG 2101- Materials and Dynamics
Lab Assignment #6- Simple Pendulum
Assigned: 11/05/2021
Due: 11/12/2021
Submitted by: Erik Smith

- B.25
Section

Table of contents:

Introduction.....	Page 1
Theory.....	Page 1
Materials and Methods.....	Page 1
Test Procedure.....	Page 2
Detailed Results.....	Page 2
Discussion of Results.....	Page 3
Conclusion.....	Page 3
Appendix.....	Page 4 and Page 5

Introduction:

During this laboratory experiment we were tasked to investigate the effect of a few different physical variables on the period of a simple pendulum. The variables that we were tasked to consider are the length of the pendulum and the angle of initial dislocation. We were tasked to observe a pendulum simulation and make three measurements of the period.

Theory:

A simple pendulum consists of a mass (m) hanging from a string with a certain length and a fixed pivot point. When you move this mass to an initial angle and released, the pendulum will swing back and forth with periodic motion. Applying Newton's second law for rotational systems, the equation of motion for the pendulum may be obtained:

$$\tau = I * \alpha \Rightarrow -m * g \sin\theta * (L) = m * L^2 \frac{d^2\theta}{d * t^2}$$

And can be rearranged as,

$$\frac{d^2\theta}{d * t^2} + \frac{g}{L} \sin\theta = 0$$

Equation of simple harmonic motion,

$$\frac{d^2\theta}{d * t^2} + \frac{g}{L} \theta = 0$$

Natural frequency of the motion,

$$\omega = \sqrt{g/L}$$

The period of the pendulum does not depend on the mass or initial angular displacement, but depends solely on the length of the string and gravitational force value:

$$T = 2\pi \sqrt{\frac{L}{g}}$$

Test Procedures:

- Set the angle to 40 degrees for the first part and set the mass to 1-kg.
- Change the length of the pendulum for 3 different trails
- Record the data and calculate the period of oscillations for each length by dividing by 20 which was the total amount of oscillations.
- For the second part we set the length equal to .6 m for the second three trails.
- We kept the length the same and changed the angles in increments of 10 degrees starting at 25 degrees.
- Record the data and calculate the period of oscillations for each length by dividing by 20 which was the total amount of oscillations.
- Collect all data and found the average for both part one and part 2.
- Draw a conclusion.

Detailed Results:

Part 1	Trail 1	Trail 2	Trail 3
✓ Length in meters	0.60	0.7	0.8
✓ Square feet (L)	0.36	0.49	0.64
✓ Period (T)	1.613	1.75	1.8645
✓ Average	1.74		
✓ % Error			

Parameters	Trail 1	Trail 2	Trail 3
Angle (θ)	25	35	45
Period (T)	1.5725	1.5815	1.62
Average	1.591		
% Error			

- 2 Pt Incomplete Data Collection

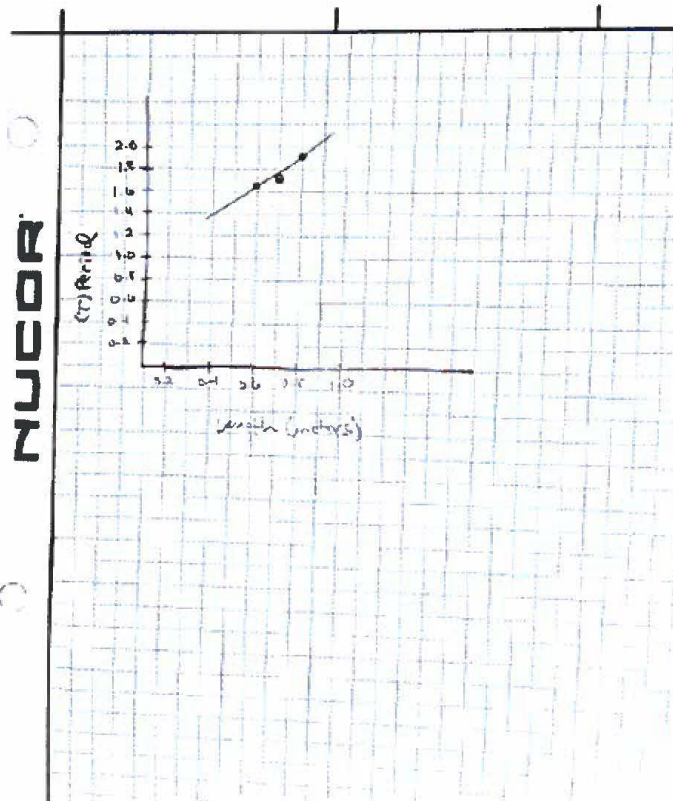
Conclusion:

After observing the laboratory experiment as well as the laboratory data, I have concluded that the period of the pendulums swing is only slightly affected when the angle of release is changed.

As well as we see a more substantial difference in the period when the length of the string is changed.

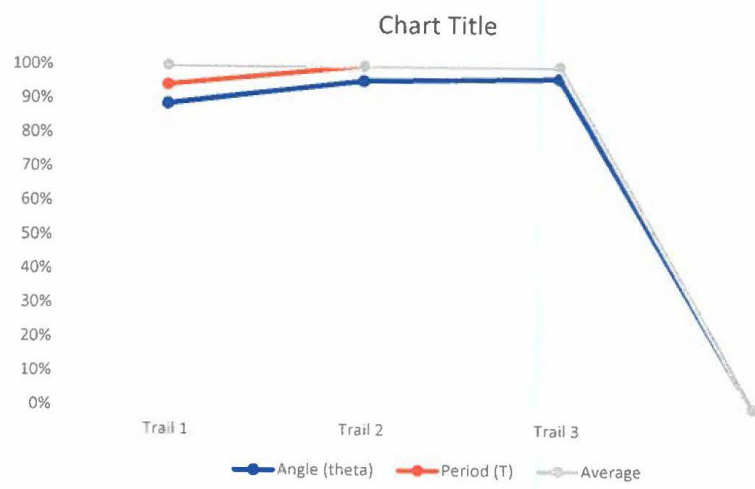
- 5pt References
- 1ept Sample Calculation

Appendix:



Scanned with CamScanner

- 5pt Missingy Plot T vs $\sqrt{L}$



BELOW AVERAGE

CIVIL ENGINEERING DEPARTMENT

PRAIRIE VIEW A&M UNIVERSITY



35

CVEG 3063 HYDRAULICS LABORATORY

-1pt
wrong course

FALL 2021

LABORATORY REPORT ON

Lab 6 – Simple Pendulum

Conducted on

November 5, 2021

Submitted by

RYAN O LOGWOOD JR

On

November 12, 2021

To

Dr. Perkins

- 5pt Table of Content

Objectives:

In this lab, the objective was to understand the effects that differing variables have on a pendulum in motion. Differing variables, includes the length of the wire used in a simple pendulum, and the angle at which the mass attached to the pendulum would be released. From thereon, the period at which the pendulum would stop was to be recorded three times. Then, angle dependence was to be calculated.

Introduction and Overview:

As pulley is a device that can increase the magnitude of an effort force. Nonetheless, the more mass applied to a pulley would result in than increase in the magnitude of said penulum.

Angle dependance was to be calculated while length remains the same, then length dependance was to be calculated while the angle remained the same.

- 10pt Theory

Procedure:

For this experiment, an online display of a pendulum was used – possibly to save time. In an imperfect world, gravitational pull was applied to the online pendulum. Nonetheless, a length of 30mm, 50mm, and 1mm was used to calculate the dependency of length. The same would be done for angle dependence, with 10 degrees, 35 degrees, and 45 degrees being used.

Data Presentation: Below is the calculations found for Length and angle dependence

Below is calculations taken by my group member, and I, respectively.

parameters	T1	T2	T3
angle	10	35	45
period	1.865	2.83	2.946
average			

- 4pt Incomplete Data Collection

Sources of Error:

No sources of error was made, with it being online.

- 10pt Discussion of the Test Result
- 5pt References
- 5pt Appendix
- 15pt Missing Graphs (T vs L , T vs $\sqrt{L}$ & T vs $\sin\theta$)
- 10pt Sample Calculation.

MATERIALS & DYNAMICS LAB
FALL 2021

ASSIGNMENT 7 – Laboratory Assignment #7 - Rotational Devices (Rigid Body)

TOPICS COVERED IN LABORATORY ASSIGNMENT 7

Laboratory Assignment 7 covered the following topics:

1. Mass Moment of Inertia for a Disk
2. Mass Moment of Inertia for a Ring
3. Angular Acceleration
4. Torque

ASSIGNMENT STATEMENT/QUESTIONS
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 7 – Rotational Devices (Rigid Body)
Given: December 3, 2021
Due December 3, 2021 no later than 11:30am CST

Purpose

The purpose of this exercise is to examine the Mass Moment of Inertia of both a ring and disk, and to experimentally confirm that the Mass Moment of Inertia of an object is a function of both its mass and how that mass is spatially distributed.

Theoretical Calculation Section

Let us assume there is a mass m , initially at rest, that is attached to one end of a massless rod of length r , and the other end of the rod is attached to a frictionless pivot that is free to rotate 360° . If one were to apply a net force F to the mass it would induce rotational motion about the pivot point, but only the component of the applied force that is tangential (at a right angle) to the length r would contribute to the change in motion of the mass. By Newton's Second Law we know the tangential force would be related to the tangential acceleration by the following equation:

$$F_T = ma_T$$

The torque acting about the point of rotation that is associated with the tangential component of the applied force would be given by:

$$\tau = F_T r = m r a_T$$

We also know that the angular acceleration that the mass is experiencing is related to its tangential acceleration by $a_T = r\alpha$, so we can insert that into the equation, giving us:

$$\tau = m r^2 \alpha$$

What would happen if you would apply a force to a rigid body (solid object) that is fixed in location, but free to rotate about an axis? Now a rigid body is just a collection of the point masses that make the total mass M of the rigid body. Each of those point masses m_i will have its own direct line distance r_i from the axis of rotation and itself. So for each point mass we could go through the exact same argument as we just went through to arrive at a similar equation;

$$\tau_i = m_i r_i^2 \alpha$$

The infinitesimal amount of torque τ_i for each point mass is the product of the term $m_i r_i^2$ and α the angular acceleration of the rigid body. The angular acceleration does not have a subscript on it because as a rigid body all the point masses rotate together, so all the point masses have the

exact same angular acceleration. To find the total torque acting on the entire rigid body you simply sum up all the torques acting on all the point masses.

$$I = \sum_i^n (m_i r_i^2) \alpha$$

The summation term is given a name. It is called the Mass Moment of Inertia of the rigid body, and its SI units are $\text{kg} \cdot \text{m}^2$

$$I = \sum_i^n (m_i r_i^2)$$

This allows us to rewrite our equation as

$$\tau = I \alpha$$

The Mass Moment of Inertia is a quantification of how difficult (or easy) it is to get an object to change its current state of rotational motion about a particular axis or rotation. The value of the summation of the term $m_i r_i^2$ will depend on the total mass of the rigid body, its shape, and the axis of rotation that is picked. However, the summation will always have the following basic algebraic form:

$$I = \sum_i^n (m_i r_i^2) = CMr^2$$

Here M is the total mass of the object, r is the 'radius' of the object, and C is a coefficient dependent on the shape of the object. A chart of the Mass Moment of Inertia of some basic geometric shapes with uniform mass is given.

From the free body diagram and force summation equations of the system, we see that the tension in the string will be: $T = mhg - mhaT = mh(g - aT)$ Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us: $I = r \cdot mh(g - aT)aTr = r^2 \cdot mh(gaT - aTaT)$ $I = r^2 \cdot mh(gaT - 1)$ This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

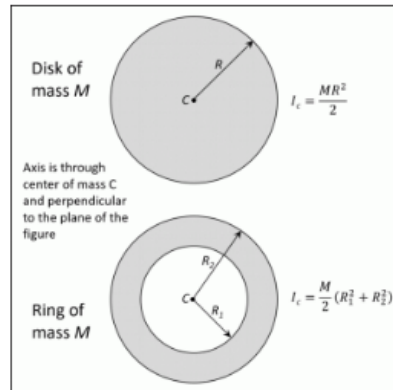


Figure 1 Therotical Value Equation of the Mass Moment of Inertia of Various Bodies

Note: a hollow cylinder is also known as a ring. The difference between the hollow cylinder and the thin-walled cylinder is that for the thin-walled cylinder the outer and inner radii are so close in value that they can be treated as being of the same value, while for the regular hollow cylinder that isn't true.

Experimental Calculation Section

One way to measure the Mass Moment of Inertia of a rigid body experimentally is to attach it to a fixed pivot point allowing for rotation in the horizontal plane, apply a known constant torque to it, then measure its tangential acceleration, and finally do a little algebra. One step up that can be used to do this is a two-pulley system. One horizontal pulley centered about the pivot point, and another vertical pulley. A string will be wrapped around the first pulley, and then strung over the vertical pulley with a known mass mh attached to it. The mass will be released, causing a constant tension in the string, which will in turn cause a constant torque about the first pulley, finally resulting in the system experiencing a constant acceleration.

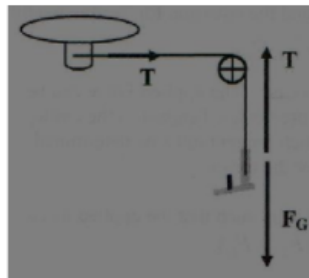


Figure 2 Rotation Disk Diagram

Stop and Review the Video Link (Mass Moment of Inertia of a Rigid Body)

<https://youtu.be/9UnUALoQsdw>

In such a setup we start with the basic equation relating the applied torque to the Mass Moment of Inertia.

$$\tau = I\alpha$$

So the Mass Moment of Inertia will be the torque divided by the angular acceleration of the system.

$$I = \frac{\tau}{\alpha}$$

From the free body diagram and force summation equations of the system, we see that the tension in the string will be:

$$T = m_h g - m_h a_T = m_h (g - a_T)$$

Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us:

$$I = \frac{r \cdot m_h (g - a_T)}{\frac{a_T}{r}} = r^2 \cdot m_h \left(\frac{g}{a_T} - \frac{a_T}{a_T} \right)$$

$$I = r^2 \cdot m_h \left(\frac{g}{a_T} - 1 \right)$$

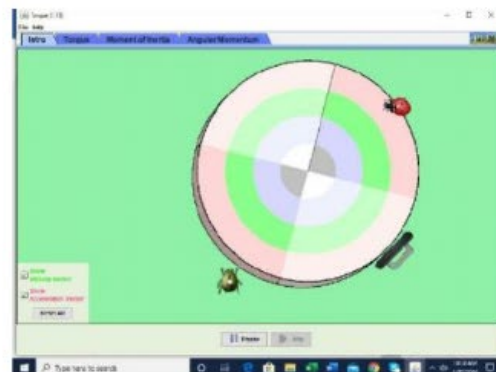
This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

Setup

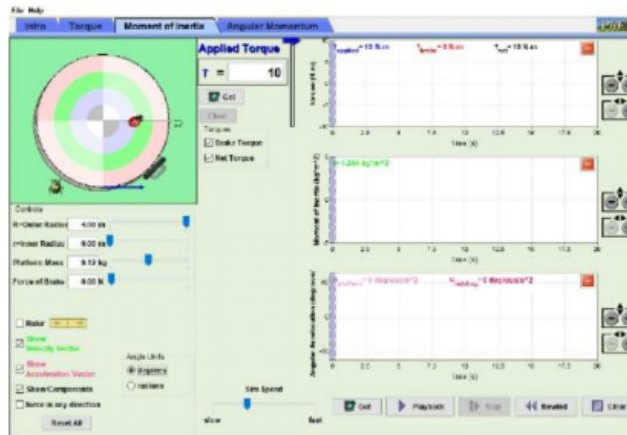
1. Go to the following website: <https://phet.colorado.edu/en/simulation/legacy/torque>
2. You should now see the following:



3. Click on “Download”, and then open the software when it has completed downloading
4. You should now see the following: (Ignore the ladybug, and the other bug. They won’t be used in our experiment)



5. Click on the Mass Moment of Inertia tab located near the top left of your screen. Afterwards you should see the following:



6. Near the bottom left of your screen you will see where you can select the Angle Units; select radians.
7. On the right side of your screen, you will see three graphs, and in the top left corner of each graph you will see the values of each graph, T_{applied} , I_{platform} , and α_{platform} . These are the values you will be recording in your data tables.

Procedure for Disk

Disk Trail 1

1. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - a. Set Outer Radius to 4.0 m and record this value in the data table for Disk.
 - b. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - c. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - d. Set Force of Brake to 0.0 N
2. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Disk.
3. Right below the Applied Torque settings click on the Go button to start the experiment.
4. Record the values for T_{applied} , I_{platform} , and α_{platform} in the table for Disk.

Disk Trail 2

5. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - e. Set Outer Radius to 5.0 m and record this value in the data table for Disk.
 - f. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - g. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - h. Set Force of Brake to 0.0 N
6. Repeat Step 2 – 4

Procedure for Ring

Ring Trail 1

7. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - i. Set Outer Radius to 4.0 m, and record this value in the data table for Ring
 - j. Set Inner Radius to 3.5 m
 - k. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - l. Set Force of Break to 0.0 N
8. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Ring.
9. Right below the Applied Torque settings click on the Go button to start the experiment.
10. Record the values for T_{applied} , I , and α_{platform} in the table for Ring.

Ring Trail 2

11. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - m. Set Outer Radius to 5.0 m and record this value in the data table for Ring.
 - n. Set Inner Radius to 4.0 m.
 - o. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - p. Set Force of Break to 0.0 N
12. Repeat Step 8 – 10

Result

Fill out the Table Shown below (5pt.)

	Outer Radius (m)	Inner Radius(m)	Mass (kg)	Torque (Nm)	α (rad/s ²)	I (kgm ²)
Disk 1	4		0.2	10		
Disk 2	5		0.2	10		
Ring 1	4	3.5	0.2	10		
Ring 2	5	4	0.2	10		

1. Calculate the experimental value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (10 pt.)

2. Calculate the theoretical value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

3. Calculate the experimental value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (10pt.)

4. Calculate the theoretical value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

5. Using the theoretical value as the accepted value, calculate the % error for the disk 1 & 2, and show work. (15pt.)

6. Using the theoretical value as the accepted value, calculate the % error for the Ring 1 & 2 and show work. (15pt.)

Discussion

1. If you repeated this experiment with a larger Applied Torque, should that change the values you would obtain for the Mass Moment of Inertia of the ring and disk? Justify your answer. (10pt.)
2. Do the results of our experiment match the theoretical predictions for the Mass Moment of Inertia of our two objects? Justify your answer? (5pt.)

GRADING SCHEME FOR ASSIGNMENT
Prairie View A&M University
Roy G. Perry College of Engineering
Civil & Environmental Engineering Department
CVEG 2101- Materials & Dynamics Lab
Lab Assignment – 7 – Rotational Devices (Rigid Body)
Given: December 3, 2021
Due December 3, 2021 no later than 11:30am CST

Results

Fill out the Table Shown below (5pt.)

	Outer Radius (m)	Inner Radius(m)	Mass (kg)	Torque (Nm)	α (rad/s ²)	I (kgm ²)
Disk 1	4		0.2	10	6.25	1.6
Disk 2	5 3		0.2	10	11.157	0.896
Ring 1	4	3.5	0.2	10	3.54	2.82
Ring 2	5 4	Discard 4 3	0.2	10	4.017	2.49

1. Calculate the experimental value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (10 pt.)

$$\text{Disk 1} = T/a = 10/6.25 = 1.6 \text{ kgm}^2$$

$$\text{Disk 2} = T/a = 10/11.157 = 0.896 \sim 0.9 \text{ kgm}^2$$

2. Calculate the theoretical value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

$$\text{Disk 1} = MR^2/2 = 0.2(4)^2/2 = 1.6 \text{ kgm}^2$$

$$\text{Disk 2} = MR^2/2 = 0.2(3)^2/2 = 0.9 \text{ kgm}^2$$

3. Calculate the experimental value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (10pt.)

$$\text{Ring 1} = T/a = 10/3.54 = 2.824 \sim 2.82 \text{ kgm}^2$$

$$\text{Ring 2} = T/a = 10/4.017 = 2.489 \sim 2.49 \text{ kgm}^2$$

4. Calculate the theoretical value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

$$\text{Ring 1} = (M) (R_1^2 + R_2^2)/2 = 0.2(4^2 + 3.5^2)/2 = 2.825 \sim 2.83 \text{ kgm}^2$$

$$\text{Ring 2} = (M) (R_1^2 + R_2^2)/2 = 0.2(4^2 + 3^2)/2 = 2.5 \text{ kgm}^2$$

5. Using the theoretical value as the accepted value, calculate the % error for the disk 1 & 2, and show work. (15pt.)

$$\text{Disk 1} = [(\text{Act} - \text{Ext})/\text{Ext}] (100) = [(1.6 - 1.6)/(1.6)] (100) = 0 \%$$

$$\text{Disk 2} = [(\text{Act} - \text{Ext})/\text{Ext}] (100) = [(0.9 - 0.9)/(0.9)] (100) = 0 \%$$

6. Using the theoretical value as the accepted value, calculate the % error for the Ring 1 & 2 and show work. (15pt.)

$$\text{Ring 1} = [(\text{Act} - \text{Ext})/\text{Ext}] (100) = [(2.83 - 2.82)/(2.82)] (100) = 0.35 \%$$

$$\text{Ring 2} = [(\text{Act} - \text{Ext})/\text{Ext}] (100) = [(2.5 - 2.49)/(2.49)] (100) = 0.40 \%$$

Discussion

1. If you repeated this experiment with a larger Applied Torque, should that change the values you would obtain for the Mass Moment of Inertia of the ring and disk? Justify your answer. (10pt.)

No, the Mass Moment of Inertia would not change if one increase the Applied Torque. What would change is the Angular Acceleration when Torque is increased.

2. Do the results of our experiment match the theoretical predictions for the Mass Moment of Inertia of our two objects? Justify your answer. (5pt.)

Yes, due to the percentage error calculation is less than 5%.

ABOVE AVERAGE

Omar Hajo

Dec 3, 2021

Rotational Disk (Rigid Body) Lab

100
100

Purpose

The purpose of this exercise is to examine the Mass Moment of Inertia of both a ring and disk, and to experimentally confirm that the Mass Moment of Inertia of an object is a function of both its mass and how that mass is spatially distributed.

Theoretical Calculation Section

Let us assume there is a mass m , initially at rest, that is attached to one end of a massless rod of length r , and the other end of the rod is attached to a frictionless pivot that is free to rotate 360° . If one were to apply a net force F to the mass it would induce rotational motion about the pivot point, but only the component of the applied force that is tangential (at a right angle) to the length r would contribute to the change in motion of the mass. By Newton's Second Law we know the tangential force would be related to the tangential acceleration by the following equation:

$$F_T = mar$$

The torque acting about the point of rotation that is associated with the tangential component of the applied force would be given by:

$$\tau = F_T r = mar$$

We also know that the angular acceleration that the mass is experiencing is related to its tangential acceleration by $ar = r\alpha$, so we can insert that into the equation, giving us:

$$\tau = mr^2\alpha$$

What would happen if you would apply a force to a rigid body (solid object) that is fixed in location, but free to rotate about an axis? Now a rigid body is just a collection of the point masses that make the total mass M of the rigid body. Each of those point masses m_i will have its own direct line distance r_i from the axis of rotation and itself. So for each point mass we could go through the exact same argument as we just went through to arrive at a similar equation;

$$\tau_i = m_i r_i^2 \alpha$$

The infinitesimal amount of torque τ_i for each point mass is the product of the term $m_i r_i^2$ and α the angular acceleration of the rigid body. The angular acceleration does not have a subscript on it because as a rigid body all the point masses rotate together, so all the point masses have the exact same angular acceleration. To find the total torque acting on the entire rigid body you simply sum up all the torques acting on all the point masses.

$$I = \sum_i^n (m_i r_i^2) \alpha$$

The summation term is given a name. It is called the Mass Moment of Inertia of the rigid body, and its SI units are $\text{kg} \cdot \text{m}^2$

$$I = \sum_i^n (m_i r_i^2)$$

This allows us to rewrite our equation as

$$\tau = I\alpha$$

The Mass Moment of Inertia is a quantification of how difficult (or easy) it is to get an object to change its current state of rotational motion about a particular axis or rotation. The value of the summation of the term $m_i r_i^2$ will depend on the total mass of the rigid body, its shape, and the axis of rotation that is picked. However, the summation will always have the following basic algebraic form:

$$I = \sum_i^n (m_i r_i^2) = CMr^2$$

Here M is the total mass of the object, r is the 'radius' of the object, and C is a coefficient dependent on the shape of the object. A chart of the Mass Moment of Inertia of some basic geometric shapes with uniform mass is given.

From the free body diagram and force summation equations of the system, we see that the tension in the string will be: $T = mhg - mhaT = mh(g - aT)$ Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us: $I = r \cdot mh(g - aT)aTr = r^2 \cdot mh(gaT - aTaT)$ $I = r^2 \cdot mh(gaT - 1)$ This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

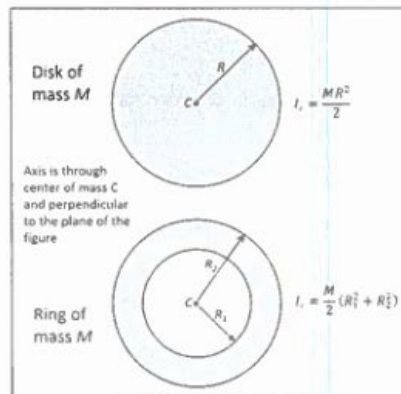


Figure 1 Therotical Value Equation of the Mass Moment of Inertia of Various Bodies

Note: a hollow cylinder is also known as a ring. The difference between the hollow cylinder and the thin-walled cylinder is that for the thin-walled cylinder the outer and inner radii are so close in value that they can be treated as being of the same value, while for the regular hollow cylinder that isn't true.

Experimental Calculation Section

One way to measure the Mass Moment of Inertia of a rigid body experimentally is to attach it to a fixed pivot point allowing for rotation in the horizontal plane, apply a known constant torque to it, then measure its tangential acceleration, and finally do a little algebra. One step up that can be used to do this is a two-pulley system. One horizontal pulley centered about the pivot point, and another vertical pulley. A string will be wrapped around the first pulley, and then strung over the vertical pulley with a known mass m_h attached to it. The mass will be released, causing a constant tension in the string, which will in turn cause a constant torque about the first pulley, finally resulting in the system experiencing a constant acceleration.

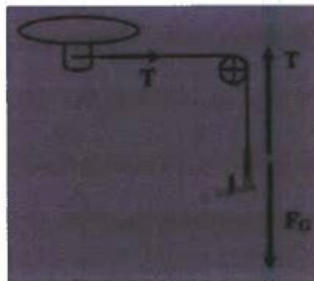


Figure 2 Rotation Disk Diagram

Stop and Review the Video Link (Mass Moment of Inertia of a Rigid Body)

<https://youtu.be/9UnUALoQsdw>

In such a setup we start with the basic equation relating the applied torque to the Mass Moment of Inertia.

$$\tau = I\alpha$$

So the Mass Moment of Inertia will be the torque divided by the angular acceleration of the system.

$$I = \frac{\tau}{\alpha}$$

From the free body diagram and force summation equations of the system, we see that the tension in the string will be:

$$T = m_h g - m_h a_T = m_h (g - a_T)$$

Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us:

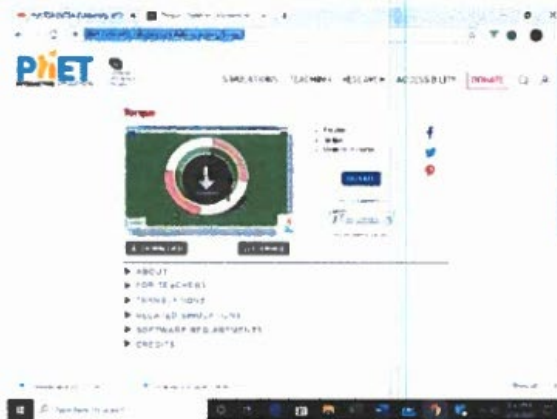
$$I = \frac{r \cdot m_h (g - a_T)}{\frac{a_T}{r}} = r^2 \cdot m_h \left(\frac{g}{a_T} - 1 \right)$$

$$I = r^2 \cdot m_h \left(\frac{g}{a_T} - 1 \right)$$

This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

Setup

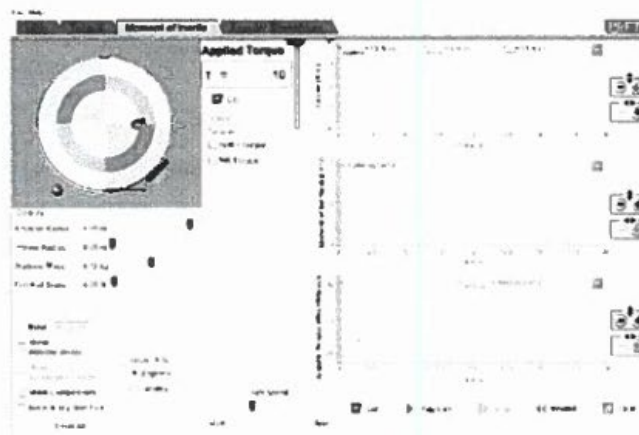
1. Go to the following website: <https://phet.colorado.edu/en/simulation/legacy/torque>
2. You should now see the following:



3. Click on "Download", and then open the software when it has completed downloading
4. You should now see the following: (Ignore the ladybug, and the other bug. They won't be used in our experiment)



5. Click on the Mass Moment of Inertia tab located near the top left of your screen. Afterwards you should see the following:



6. Near the bottom left of your screen you will see where you can select the Angle Units; select radians.
7. On the right side of your screen, you will see three graphs, and in the top left corner of each graph you will see the values of each graph, T_{applied} , I , and α_{platform} . These are the values you will be recording in your data tables.
- 8.

Procedure for Disk

Disk Trail 1

1. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - a. Set Outer Radius to 4.0 m and record this value in the data table for Disk.
 - b. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - c. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - d. Set Force of Break to 0.0 N
2. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Disk.
3. Right below the Applied Torque settings click on the Go button to start the experiment.
4. Record the values for T_{applied} , I , and α_{platform} in the table for Disk.

Disk Trail 2

5. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - e. Set Outer Radius to 5.0 m and record this value in the data table for Disk.
 - f. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - g. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - h. Set Force of Break to 0.0 N

6. Repeat Step 2 – 4

Procedure for Ring

Ring Trail 1

7. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - i. Set Outer Radius to 4.0 m, and record this value in the data table for Ring
 - j. Set Inner Radius to 3.5 m
 - k. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - l. Set Force of Break to 0.0 N
8. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Ring.
9. Right below the Applied Torque settings click on the Go button to start the experiment.
10. Record the values for T_{applied} , I , and α_{platform} in the table for Ring.

Ring Trail 2

11. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - m. Set Outer Radius to 5.0 m and record this value in the data table for Ring.
 - n. Set Inner Radius to 4.0 m.
 - o. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - p. Set Force of Break to 0.0 N
12. Repeat Step 8 – 10

Result

+5

Fill out the Table Shown below (5pt.)

	Outer Radius (m)	Inner Radius(m)	Mass (kg)	Torque (Nm)	α (rad/s ²)	I (kgm ²)
✓ Disk 1	4	0	0.2	10	6.25	1.6
✓ Disk 2	3	0	0.2	10	11.11	0.9
✓ Ring 1	4	3.5	0.2	10	3.54	2.825
✓ Ring 2	4	3	0.2	10	4	2.5

$$\text{Disk 1} = I = \frac{0.2(4)^2}{2} = 1.6 \text{ kgm}^2 \quad \text{Exp} = \frac{10}{6.25} = 1.6 \text{ kgm}^2$$

$$\text{Disk 2} = I = \frac{0.2(3)^2}{2} = 0.9 \text{ kgm}^2 \quad \text{Exp} = \frac{10}{11.11} = 0.90 \text{ kgm}^2$$

$$\text{Ring 1} = I = \frac{0.2}{2} (4^2 + 3.5^2) = 2.825 \text{ kgm}^2 \quad \text{Exp} = \frac{10}{3.54} = 2.825 \text{ kgm}^2$$

$$\text{Ring 2} = I = \frac{0.2}{2} (4^2 + 3^2) = 2.5 \text{ kgm}^2 \quad \text{Exp} = \frac{10}{4} = 2.5 \text{ kgm}^2$$

$$\text{Disk 1} = 1.6 - 1.6 = 0\% \quad \text{Ring 1} = 2.825 - 2.825 = 0\%$$

Dish 1

$$I = (4^2 + 3.5^2) =$$

$$E_{XD} =$$

1. Calculate the experimental value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (10 pt.)

See Page 7 (1)

2. Calculate the theoretical value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

See Page 7 (2)

3. Calculate the experimental value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (10pt.)

See Page 7 (3)

4. Calculate the theoretical value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

See Page 7 (4)

5. Using the theoretical value as the accepted value, calculate the % error for the disk 1 & 2, and show work. (15pt.)

See Page 7 (5)

6. Using the theoretical value as the accepted value, calculate the % error for the Ring 1 & 2 and show work. (15pt.)

See Page 7 (6)

Discussion

1. If you repeated this experiment with a larger Applied Torque, should that change the values you would obtain for the Mass Moment of Inertia of the ring and disk? Justify your answer. (10pt.)

+10

As the applied torque is increased, the acceleration increases and the moment of inertia remains constant.

The size of the ring and disk will change the moment of inertia. Also the mass used will change it.

2. Do the results of our experiment match the theoretical predictions for the Mass Moment of Inertia of our two objects? Justify your answer? (5pt.)

+5

Yes, the results match the theoretical predictions. The % error between the theoretical and experimental values is 0%.

AVERAGE

95
100

Rotational Disk (Rigid Body) Lab

Purpose

The purpose of this exercise is to examine the Mass Moment of Inertia of both a ring and disk, and to experimentally confirm that the Mass Moment of Inertia of an object is a function of both its mass and how that mass is spatially distributed.

Theoretical Calculation Section

Let us assume there is a mass m , initially at rest, that is attached to one end of a massless rod of length r , and the other end of the rod is attached to a frictionless pivot that is free to rotate 360° . If one were to apply a net force F to the mass it would induce rotational motion about the pivot point, but only the component of the applied force that is tangential (at a right angle) to the length r would contribute to the change in motion of the mass. By Newton's Second Law we know the tangential force would be related to the tangential acceleration by the following equation:

$$F_T = ma_T$$

The torque acting about the point of rotation that is associated with the tangential component of the applied force would be given by:

$$\tau = F_T r = m r a_T$$

We also know that the angular acceleration that the mass is experiencing is related to its tangential acceleration by $a_T = r\alpha$, so we can insert that into the equation, giving us:

$$\tau = m r^2 \alpha$$

What would happen if you would apply a force to a rigid body (solid object) that is fixed in location, but free to rotate about an axis? Now a rigid body is just a collection of the point masses that make the total mass M of the rigid body. Each of those point masses m_i will have its own direct line distance r_i from the axis of rotation and itself. So for each point mass we could go through the exact same argument as we just went through to arrive at a similar equation;

$$\tau_i = m_i r_i^2 \alpha$$

The infinitesimal amount of torque τ_i for each point mass is the product of the term $m_i r_i^2$ and α the angular acceleration of the rigid body. The angular acceleration does not have a subscript on it because as a rigid body all the point masses rotate together, so all the point masses have the exact same angular acceleration. To find the total torque acting on the entire rigid body you simply sum up all the torques acting on all the point masses.

$$I = \sum_i^n (m_i r_i^2) \alpha$$

The summation term is given a name. It is called the Mass Moment of Inertia of the rigid body, and its SI units are $\text{kg} \cdot \text{m}^2$

$$I = \sum_i^n (m_i r_i^2)$$

This allows us to rewrite our equation as

$$\tau = I\alpha$$

The Mass Moment of Inertia is a quantification of how difficult (or easy) it is to get an object to change its current state of rotational motion about a particular axis or rotation. The value of the summation of the term $m_i r_i^2$ will depend on the total mass of the rigid body, its shape, and the axis of rotation that is picked. However, the summation will always have the following basic algebraic form:

$$I = \sum_i^n (m_i r_i^2) = CMr^2$$

Here M is the total mass of the object, r is the 'radius' of the object, and C is a coefficient dependent on the shape of the object. A chart of the Mass Moment of Inertia of some basic geometric shapes with uniform mass is given.

From the free body diagram and force summation equations of the system, we see that the tension in the string will be: $T = mhg - mhaT = mh(g - aT)$ Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us: $I = r \cdot mh(g - aT)aTr = r^2 \cdot mh(gaT - aTaT)$ $I = r^2 \cdot mh(gaT - 1)$ This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

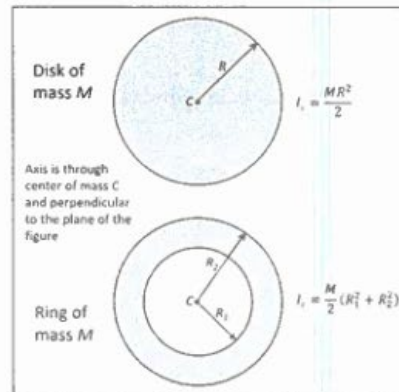


Figure 1 Therotical Value Equation of the Mass Moment of Inertia of Various Bodies

Note: a hollow cylinder is also known as a ring. The difference between the hollow cylinder and the thin-walled cylinder is that for the thin-walled cylinder the outer and inner radii are so close in value that they can be treated as being of the same value, while for the regular hollow cylinder that isn't true.

Experimental Calculation Section

One way to measure the Mass Moment of Inertia of a rigid body experimentally is to attach it to a fixed pivot point allowing for rotation in the horizontal plane, apply a known constant torque to it, then measure its tangential acceleration, and finally do a little algebra. One step up that can be used to do this is a two-pulley system. One horizontal pulley centered about the pivot point, and another vertical pulley. A string will be wrapped around the first pulley, and then strung over the vertical pulley with a known mass m_h attached to it. The mass will be released, causing a constant tension in the string, which will in turn cause a constant torque about the first pulley, finally resulting in the system experiencing a constant acceleration.

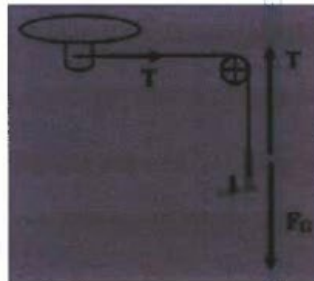


Figure 2 Rotation Disk Diagram

Stop and Review the Video Link (Mass Moment of Inertia of a Rigid Body)

<https://youtu.be/9UnUALoQsdw>

In such a setup we start with the basic equation relating the applied torque to the Mass Moment of Inertia.

$$\tau = I\alpha$$

So the Mass Moment of Inertia will be the torque divided by the angular acceleration of the system.

$$I = \frac{\tau}{\alpha}$$

From the free body diagram and force summation equations of the system, we see that the tension in the string will be:

$$T = m_h g - m_h a_T = m_h (g - a_T)$$

Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us:

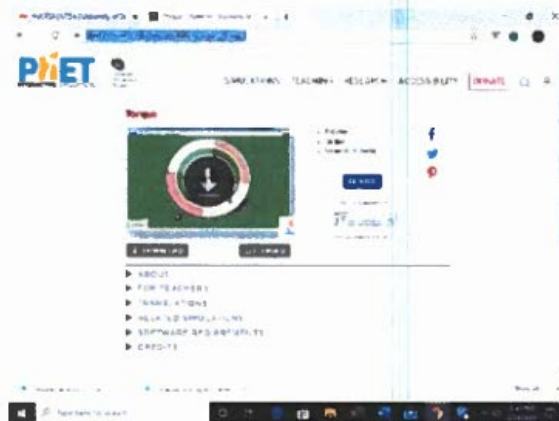
$$I = \frac{r \cdot m_h (g - a_T)}{\frac{a_T}{r}} = r^2 \cdot m_h \left(\frac{g}{a_T} - \frac{a_T}{a_T} \right)$$

$$I = r^2 \cdot m_h \left(\frac{g}{a_T} - 1 \right)$$

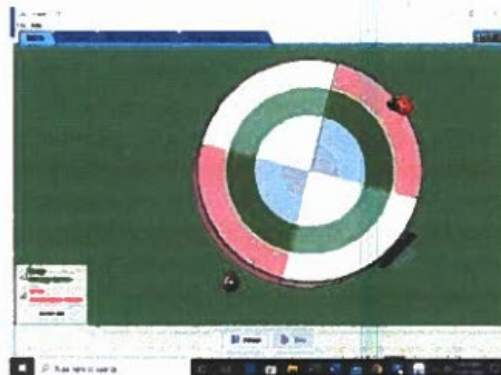
This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

Setup

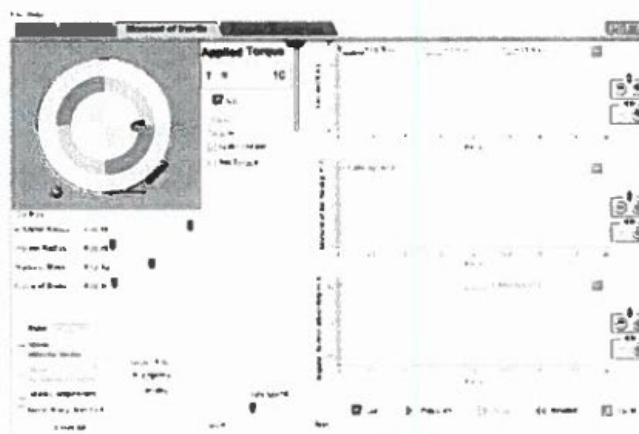
1. Go to the following website: <https://phet.colorado.edu/en/simulation/legacy/torque>
2. You should now see the following:



3. Click on "Download", and then open the software when it has completed downloading
4. You should now see the following: (Ignore the ladybug, and the other bug. They won't be used in our experiment)



5. Click on the Mass Moment of Inertia tab located near the top left of your screen. Afterwards you should see the following:



6. Near the bottom left of your screen you will see where you can select the Angle Units; select radians.
7. On the right side of your screen, you will see three graphs, and in the top left corner of each graph you will see the values of each graph, T_{applied} , I , and α_{platform} . These are the values you will be recording in your data tables.
- 8.

Procedure for Disk

Disk Trail 1

1. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - a. Set Outer Radius to 4.0 m and record this value in the data table for Disk.
 - b. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - c. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - d. Set Force of Break to 0.0 N
2. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Disk.
3. Right below the Applied Torque settings click on the Go button to start the experiment.
4. Record the values for T_{applied} , I , and α_{platform} in the table for Disk.

Disk Trail 2

5. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - e. Set Outer Radius to 5.0 m and record this value in the data table for Disk.
 - f. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - g. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - h. Set Force of Break to 0.0 N

6. Repeat Step 2 – 4

Procedure for Ring

Ring Trail 1

7. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - i. Set Outer Radius to 4.0 m, and record this value in the data table for Ring
 - j. Set Inner Radius to 3.5 m
 - k. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - l. Set Force of Break to 0.0 N
8. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Ring.
9. Right below the Applied Torque settings click on the Go button to start the experiment.
10. Record the values for T_{applied} , I , and α_{platform} in the table for Ring.

Ring Trail 2

11. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - m. Set Outer Radius to 5.0 m and record this value in the data table for Ring.
 - n. Set Inner Radius to 4.0 m.
 - o. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - p. Set Force of Break to 0.0 N
12. Repeat Step 8 – 10

Result

+5 Fill out the Table Shown below (5pt.)

CALCULATIONS $\Rightarrow$

	Outer Radius (m)	Inner Radius(m)	Mass (kg)	Torque (Nm)	α (rad/s ²)	I (kgm ²)
✓ Disk 1	4		0.2	10	6.25	1.6
✓ Disk 2	5		0.2	10	11.157	0.896
✓ Ring 1	4	3.5	0.2	10	3.54	2.82
✓ Ring 2	5	4	0.2	10	4.017	2.49

THEORY: (2)

+15 Disk: $I = \frac{MR^2}{2}$

Disk 1: $I = \frac{(0.20\text{kg})(4.00\text{m})^2}{2} = 1.6\text{kgm}^2$

Disk 2: $I = \frac{(0.20\text{kg})(3.0\text{m})^2}{2} = 0.9\text{kgm}^2$

+15 Ring: (4) $I = \frac{M}{2} (R_1^2 + R_2^2)$

Ring 1: $I = \frac{(0.20\text{kg})}{2} (4.0\text{m}^2 + 3.5\text{m}^2) = 2.825\text{kgm}^2$

Ring 2: $I = \frac{(0.20\text{kg})}{2} (4.0\text{m}^2 + 3.0\text{m}^2) = 2.5\text{kgm}^2$

EXPECTED: $I = \frac{T}{2} (\text{rad/sec})$

ACTUAL DATA

% ERRORS +30

$\sqrt{\leq 5\%} \left(\frac{\text{Act.} - \text{Exp.}}{\text{Exp.}} \right) \times 100$

+15 (1) Disk 1: $I = \frac{(10)}{(6.25)} = 1.6\text{kgm}^2$ | 1.6

+15 (2) Disk 2: $I = \frac{(10)}{(11.157)} = 0.8963\text{kgm}^2$ | 0.896

+15 (3) Ring 1: $I = \frac{(10)}{(3.54)} = 2.825\text{kgm}^2$ | 2.82

+15 (4) Ring 2: $I = \frac{(16)}{(4.017)} = 2.489$ | 2.49

(5) Disk 1: $= \frac{1.6 - 1.6}{1.6} = 0$

(2) Disk 2: $= \frac{0.896 - 0.896}{0.896} = 0$

(6) Ring 1: $= \frac{2.825 - 2.82}{2.82} = 0$

(4) Ring 2: $= \frac{2.49 - 2.489}{2.489}$

$= 0.04\%$

1. Calculate the experimental value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (10 pt.)

See Page 7 (1)

2. Calculate the theoretical value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

See Page 7 (2)

3. Calculate the experimental value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (10pt.)

See Page 7 (3)

4. Calculate the theoretical value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

See Page 7 (4)

5. Using the theoretical value as the accepted value, calculate the % error for the disk 1 & 2, and show work. (15pt.)

See Page 7 (5)

6. Using the theoretical value as the accepted value, calculate the % error for the Ring 1 & 2 and show work. (15pt.)

See Page 7 (6)

Discussion

1. If you repeated this experiment with a larger Applied Torque, should that change the values you would obtain for the Mass Moment of Inertia of the ring and disk? Justify your answer. (10pt.)

+5
-5

ONLY THE ANGULAR MOMENTUM WOULD CHANGE,

TORQUE AND ANGULAR MOMENTUM HAVE A
DIRECT RELATIONSHIP, MEANING ANGULAR
MOMENTUM WOULD INCREASE.

→ Acceleration

IF Torque
increase the
Moment of
Inertia would
not change.

2. Do the results of our experiment match the theoretical predictions for the Mass Moment of Inertia of our two objects? Justify your answer? (5pt.)

+5

Yes. When calculated, the HIGHEST
Percent Error is 0.04%,
MUCH LESS THAN 5%.

-5 +95

BELOW AVERAGE

Tamia Ford
12/3/21

Rotational Disk (Rigid Body) Lab

80
100

Purpose

The purpose of this exercise is to examine the Mass Moment of Inertia of both a ring and disk, and to experimentally confirm that the Mass Moment of Inertia of an object is a function of both its mass and how that mass is spatially distributed.

Theoretical Calculation Section

Let us assume there is a mass m , initially at rest, that is attached to one end of a massless rod of length r , and the other end of the rod is attached to a frictionless pivot that is free to rotate 360° . If one were to apply a net force F to the mass it would induce rotational motion about the pivot point, but only the component of the applied force that is tangential (at a right angle) to the length r would contribute to the change in motion of the mass. By Newton's Second Law we know the tangential force would be related to the tangential acceleration by the following equation:

$$F_T = mar$$

The torque acting about the point of rotation that is associated with the tangential component of the applied force would be given by:

$$\tau = F_T r = m r a r$$

We also know that the angular acceleration that the mass is experiencing is related to its tangential acceleration by $a r = r \alpha$, so we can insert that into the equation, giving us:

$$\tau = m r^2 \alpha$$

What would happen if you would apply a force to a rigid body (solid object) that is fixed in location, but free to rotate about an axis? Now a rigid body is just a collection of the point masses that make the total mass M of the rigid body. Each of those point masses m_i will have its own direct line distance r_i from the axis of rotation and itself. So for each point mass we could go through the exact same argument as we just went through to arrive at a similar equation;

$$\tau_i = m_i r_i^2 \alpha$$

The infinitesimal amount of torque τ_i for each point mass is the product of the term $m_i r_i^2$ and α the angular acceleration of the rigid body. The angular acceleration does not have a subscript on it because as a rigid body all the point masses rotate together, so all the point masses have the exact same angular acceleration. To find the total torque acting on the entire rigid body you simply sum up all the torques acting on all the point masses.

$$I = \sum_i^n (m_i r_i^2) \alpha$$

The summation term is given a name. It is called the Mass Moment of Inertia of the rigid body, and its SI units are $\text{kg}\cdot\text{m}^2$

$$I = \sum_i^n (m_i r_i^2)$$

This allows us to rewrite our equation as

$$\tau = I\alpha$$

The Mass Moment of Inertia is a quantification of how difficult (or easy) it is to get an object to change its current state of rotational motion about a particular axis or rotation. The value of the summation of the term $m_i r_i^2$ will depend on the total mass of the rigid body, its shape, and the axis of rotation that is picked. However, the summation will always have the following basic algebraic form:

$$I = \sum_i^n (m_i r_i^2) = CMr^2$$

Here M is the total mass of the object, r is the 'radius' of the object, and C is a coefficient dependent on the shape of the object. A chart of the Mass Moment of Inertia of some basic geometric shapes with uniform mass is given.

From the free body diagram and force summation equations of the system, we see that the tension in the string will be: $T = mhg - mhaT = mh(g - aT)$ Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us: $I = r \cdot mh(g - aT)aTr = r^2 \cdot mh(gaT - aTaT)$ $I = r^2 \cdot mh(gaT - 1)$ This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

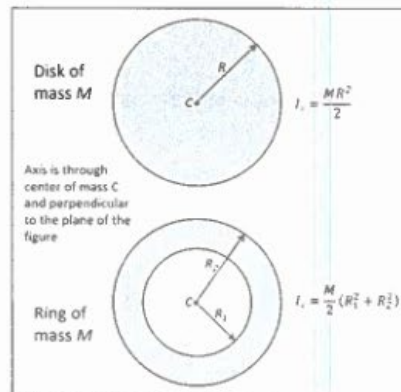


Figure 1 Therotical Value Equation of the Mass Moment of Inertia of Various Bodies

Note: a hollow cylinder is also known as a ring. The difference between the hollow cylinder and the thin-walled cylinder is that for the thin-walled cylinder the outer and inner radii are so close in value that they can be treated as being of the same value, while for the regular hollow cylinder that isn't true.

Experimental Calculation Section

One way to measure the Mass Moment of Inertia of a rigid body experimentally is to attach it to a fixed pivot point allowing for rotation in the horizontal plane, apply a known constant torque to it, then measure its tangential acceleration, and finally do a little algebra. One step up that can be used to do this is a two-pulley system. One horizontal pulley centered about the pivot point, and another vertical pulley. A string will be wrapped around the first pulley, and then strung over the vertical pulley with a known mass mh attached to it. The mass will be released, causing a constant tension in the string, which will in turn cause a constant torque about the first pulley, finally resulting in the system experiencing a constant acceleration.

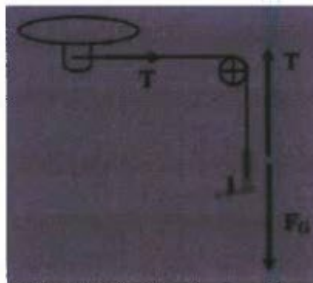


Figure 2 Rotation Disk Diagram

Stop and Review the Video Link (Mass Moment of Inertia of a Rigid Body)

<https://youtu.be/9UnUALoQsdw>

In such a setup we start with the basic equation relating the applied torque to the Mass Moment of Inertia.

$$\tau = I\alpha$$

So the Mass Moment of Inertia will be the torque divided by the angular acceleration of the system.

$$I = \frac{\tau}{\alpha}$$

From the free body diagram and force summation equations of the system, we see that the tension in the string will be:

$$T = m_h g - m_h a_T = m_h (g - a_T)$$

Inserting this for the tension, as well as the known equations for torque and angular acceleration, gives us:

$$I = \frac{r \cdot m_h (g - a_T)}{\frac{a_T}{r}} = r^2 \cdot m_h \left(\frac{g}{a_T} - \frac{a_T}{a_T} \right)$$

$$I = r^2 \cdot m_h \left(\frac{g}{a_T} - 1 \right)$$

This final equation gives the experimental value for the Mass Moment of Inertia of the rigid body, where here r is the radius of the horizontal pulley the rigid body is attached to. (Please note that in constructing this equation we assumed that the Mass Moment of Inertia of the two pulleys are so small compared to the moment inertia of the rigid body's that they were simply ignored.)

Setup

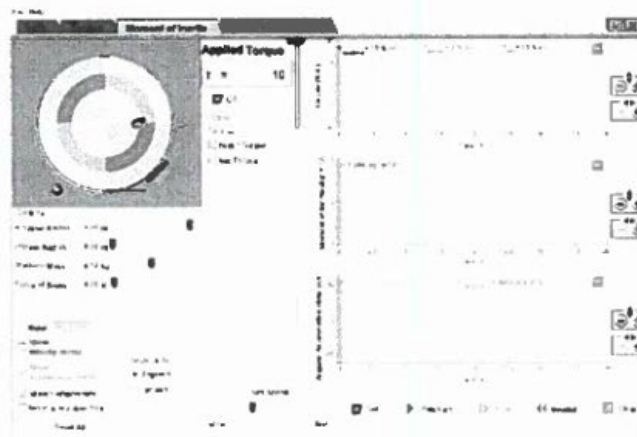
1. Go to the following website: <https://phet.colorado.edu/en/simulation/legacy/torque>
2. You should now see the following:



3. Click on "Download", and then open the software when it has completed downloading
4. You should now see the following: (Ignore the ladybug, and the other bug. They won't be used in our experiment)



5. Click on the Mass Moment of Inertia tab located near the top left of your screen. Afterwards you should see the following:



6. Near the bottom left of your screen you will see where you can select the Angle Units; select radians.
7. On the right side of your screen, you will see three graphs, and in the top left corner of each graph you will see the values of each graph, T_{applied} , I , and α_{platform} . These are the values you will be recording in your data tables.
- 8.

Procedure for Disk

Disk Trail 1

1. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - a. Set Outer Radius to 4.0 m and record this value in the data table for Disk.
 - b. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - c. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - d. Set Force of Break to 0.0 N
2. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Disk.
3. Right below the Applied Torque settings click on the Go button to start the experiment.
4. Record the values for T_{applied} , I , and α_{platform} in the table for Disk.

Disk Trail 2

5. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - e. Set Outer Radius to 5.0 m and record this value in the data table for Disk.
 - f. Set Inner Radius to 0.0 m. A Disk has no 'Inner Radius'.
 - g. Set Platform Mass to 0.20 Kg and record this value in the data table for Disk.
 - h. Set Force of Break to 0.0 N

6. Repeat Step 2 - 4

Procedure for Ring

Ring Trail 1

7. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - i. Set Outer Radius to 4.0 m, and record this value in the data table for Ring
 - j. Set Inner Radius to 3.5 m
 - k. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - l. Set Force of Break to 0.0 N
8. Near the top of your screen, and slightly off center to the left you will see the setting for the Applied Torque. Set the Applied Torque to 10 Nm, and record this in your data table for Ring.
9. Right below the Applied Torque settings click on the Go button to start the experiment.
10. Record the values for T_{applied} , I , and α_{platform} in the table for Ring.

Ring Trail 2

11. At the center left side of your screen there are the controls to select the physical properties of 'platform', which will be the disk in our experiment.
 - m. Set Outer Radius to 5.0 m and record this value in the data table for Ring.
 - n. Set Inner Radius to 4.0 m.
 - o. Set Platform Mass to 0.20 Kg and record this value in the data table for Ring.
 - p. Set Force of Break to 0.0 N
12. Repeat Step 8 - 10

$$I = \frac{MR^2}{2} \text{ (Disk)}$$

$$I = \frac{T}{\alpha} \text{ (Exp.)}$$

Result

+5

Fill out the Table Shown below (5pt.)

$$I = \frac{M}{2} (R_1^2 + R_2^2) \text{ (Ring)} \quad \% \text{ errors} = \left(\frac{I_{\text{th}} - I_{\text{exp}}}{I_{\text{exp}}} \right) \times 100$$

	Outer Radius (m)	Inner Radius (m)	Mass (kg)	Torque (Nm)	α (rad/s ²)	I (kgm ²)
✓ Disk 1	✓ 3		0.2	10	11.111	0.9
✓ Disk 2	✓ 4		0.2	10	6.25	1.6
✓ Ring 1	4	3.5	0.2	10	3.54	2.825
✓ Ring 2	✓ 4	✓ 3	0.2	10	4	2.5

Disk 1

$$I = \frac{(0.2)(3)^2}{2} = 0.9$$

1.5

$$I = \frac{(0.2)(4)^2}{2} = 1.6$$

Disk 2

$$I = \frac{(0.2)(3.5^2 + 4^2)}{2} = 2.825$$

$$I = \frac{(0.2)(3^2 + 4^2)}{2} = 2.5$$

$$I = \frac{(0.2)(4^2 + 3^2)}{2} = 2.5$$

$$I = \frac{(0.2)(4^2 + 3^2)}{2} = 2.5$$

$$I = \frac{(0.2)(4^2 + 3^2)}{2} = 2.5$$

$$I = \frac{(0.2)(4^2 + 3^2)}{2} = 2.5$$

$$I = \frac{10}{11.111} = 0.900$$

$$I = \frac{10}{6.25} = 1.6$$

$$I = \frac{10}{3.54} = 2.825$$

$$I = \frac{10}{4} = 2.5$$

$$I = \frac{10}{4} = 2.5$$

$$I = \frac{10}{4} = 2.5$$

$$\text{Theory} = \left(\frac{0.9 - 0.9}{0.9} \right) \times 100 = 0\% \text{ error}$$

= 0% error

continued on the back

Continued Theory + 30

$$2) \left(\frac{1.6 - 1.6}{1.6} \right) = 0 \% \text{ error} \quad (5)$$

$$3) \left(\frac{2.825 - 2.825}{2.825} \right) = 0 \% \text{ error} \quad (6)$$

$$4) \left(\frac{2.5 - 2.5}{2.5} \right) = 0 \% \text{ error} \quad (6)$$

1. Calculate the experimental value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (10 pt.)

See Page 7 (1)

2. Calculate the theoretical value of the Mass Moment of Inertia of the disk 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

See Page 7 (2)

3. Calculate the experimental value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (10pt.)

See Page 7 (3)

4. Calculate the theoretical value of the Mass Moment of Inertia of the ring 1 & 2 and show work. (Hint refer to Figure 1 to calculate theoretical value). (15pt.)

See Page 7 (4)

5. Using the theoretical value as the accepted value, calculate the % error for the disk 1 & 2, and show work. (15pt.)

See Page 7 (5)

6. Using the theoretical value as the accepted value, calculate the % error for the Ring 1 & 2 and show work. (15pt.)

See Page 7 (6)

Discussion

1. If you repeated this experiment with a larger Applied Torque, should that change the values you would obtain for the Mass Moment of Inertia of the ring and disk? Justify your answer. (10pt.)

+5

-5

If the experiment was repeated on a larger scale the values of the Torque, radius and inertia would change.

The torque would increase based on the larger scale and mass, along with the radius due to change in dimensions, lastly the inertia would change due to the mass plus the disk / ring.

If Torque change the Moment of Inertia would stay the same.

2. Do the results of our experiment match the theoretical predictions for the Mass Moment of Inertia of our two objects? Justify your answer? (5pt.)

+5

I can confirm that the theoretical predictions do in fact match the predictions made in the Mass Moment of Inertia. All equations came out with a 0% error for both objects, meaning there were no errors within the virtual experiment.

-20

+80