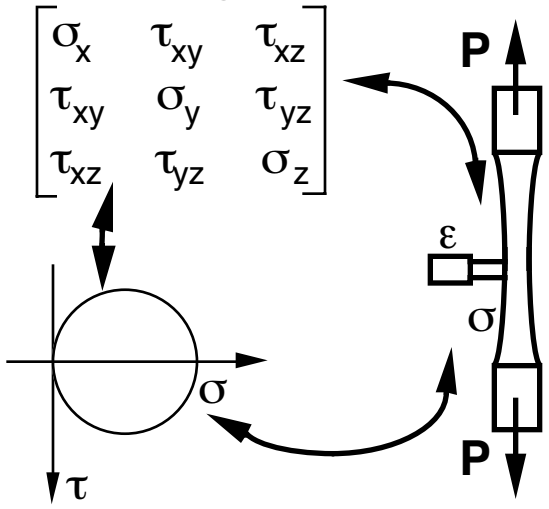
University of Washington

ME 354

Mechanics of Materials Laboratory



Course website: http://swhite.me.washington.edu/~jenkinsm/me354/

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Mechanical Engineering 354
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1. INTRODUCTION

Mechanics of Materials is generally the name applied to a discipline in which the stress, strain and deflections of loaded structural elements are considered. This set of notes presents the laboratory aspects of this subject.

For nearly all design work it is necessary to know something of the elastic and, often, plastic properties of the material to be used. While these properties are often available from handbooks, sometimes particular properties of less common materials are needed, in which case the engineer must perform his own tests. The performance of these typical tests in this laboratory will give a better feeling for the significance of the various material properties and for the accuracy with which these quantities can be determined.

The various sections of these notes are concerned with review of the subject of mechanics of materials and related material properties including the laboratory application of these principles to a simple structures. In various exercises, the stresses, strains and deflections of a both simply-supported straight and curved beams are measured and compared to analytical predictions. In another exercise, selected mechanical properties and performance of representative engineering materials are measured using standardized test methods and quantitatively compared to handbook values. The effects of stress concentrations are the focus of another exercise in which photoelasticity is used to determine stress raisers for comparisons to values obtained from compendiums. Fracture mechanics and crack interactions are examined in a study of the load carrying reduction of cracks in components. Time-dependent behaviour is evaluated through measurement and analysis of creep deformation and cyclic fatigue failures. Structural instabilities such as column buckling are compared to material strength in assessing engineering failures. Complex structures are analyzed through experimental measurements and both simple and complex analytical methods to assess the implications of oversimplifications in engineering analysis.

Laboratory Procedure

Mechanics of Materials Laboratory, ME 354, is intended to give an experimental understanding and verification of the coursework covered in Mechanics of Materials, CIVE 220 (formerly ENGR 220) and Introduction to Materials Science, MSE 170 (formerly ENGR 170). No one should be enrolled in this course who has not taken or is not currently taking MSE 170 and CIVE 220 or their equivalents.

Because of the nature of the laboratory experiments, it is necessary to conduct them as a class activity with students either observing or directly participating in the exercises. In some exercises, small by groups of students will conduct the experiment directly. In other exercises, the instructor will take the lead in operating the equipment with some students participating as assistants and others as observers and recorders. An instructor will always be available in the laboratory to introduce the exercise, describe the operation of the equipment, discuss the expected results and present the salient aspects of the analysis. Generally, students will be expected to work as teams when required but must complete written reports independently.

Some laboratory exercises require formal written reports. Other exercises require the completion of pre-formatted lab reports and their transmittal to the instructor in the form of a short memo report Still other exercises require only the completion of pre-formatted write-ups without any additional writing. All lab reports, regardless of type, must be turned in to receive a passing course grade. Missing lab reports at the time of assignment of final grades will mean the assignment of a final grade of X for one quarter following the course, regardless of the quality of the rest of the coursework, until all reports are in. Failure to complete missing lab reports or to make other arrangements after one quarter has passed following completion of the course will result in the conversion of the X to a 0.0.

Laboratory reports

Reports are the primary basis for the course grade. Examination grades and discussion participation are also considered in the final grade. Grades are important to the student for a relatively short time; report writing will be important to the student's total career.

The laboratory reports provide an opportunity for the student to sharpen writing skills and to increase the awareness of writing standards. Future employers will require standards and will judge your professional or technical ability in part on your reporting capabilities. Sherman (Sherman et al, 1975) has stated "It would be an overstatement, perhaps, to say that a career in a technical profession will be impossible if you cannot write effectively. It is no overstatement, however, to say that weakness in writing is a handicap that will weaken your qualifications for many desirable positions, and that skill in writing is an asset that can make your professional advancement faster and easier."

Technical writing involves style, neatness, grammar, usage of words, spelling, and format. Of these attributes, first five are generally applicable, whereas the sixth (i.e., format) is specific to the particular application. In the course, the format is non arbitrary and is detailed in the appendix.

Neatness: All written communications should be neat in their final form. Reports should be machine generated. Original data may be in pencil and is always included in the appendix of the report.

Grammar: Sentence structure, paragraph construction, and punctuation presumably have been learned prior to taking ME 354. Errors in grammar will be noted by the grader so that the student's writing skills will be improved.

Usage of Words: Misuse of words involves words and phrases that are problems for many writers. A few examples of such "pairs" are: affect-effect, among-between, because-for, fewer-less, like-as if, percent-portion, while-although, too-two, their-there.

Jargon is acceptable when properly used (i.e., not overused!). Specialized words are acceptable to a particular profession but should not be used to impress an "outsider." Debasing of the English language by the use of suffixes such as "ise" and "wise" is confusing and unnecessary. Colloquialisms or contractions should not be used in formal technical writing.

Style: The style of writing is determined by the potential reader. A report may be formal or informal, childish or mature, personal or impersonal, stilted or admirable, wordy or succinct. The formal laboratory report may be read by a teaching assistant or a professor, but it should be written for an engineering manager. Properly written laboratory reports may be used for reference material; well-written reports will enhance this value.

Do not copy portions of these notes word for word in your report. Statements in "your own words" will indicate understanding and descriptive conciseness ability. The use of future tense or telling "what you are going to do" does not belong in a report of what you did. Generally the tense of reports is such that anything in the report (e.g., tables, figures, section) are referred to in the present tense. Anything done to produce the results of the reports is in the past tense.

Traditionally, technical report writing has been conducted in the third person passive voice (e.g., "The tests were conducted"). The use of "I" imparts a personal tone to the report which is generally inappropriate. First person style emphasizes the writer's part in the experiment or test rather than the material or equipment used. "I" and "we" are sometimes used to reduce awkward or stilted language (such as using "one"). Such use should be kept to a minimum, particularly in the Summary.

Spelling: Spelling words properly is a problem for many students. Incorrectly spelled words, particularly simple words, indicate a juvenile approach to technical writing. To quote Sherman (Sherman et al, 1975), "Even a weak speller, if he keeps a list of the words that he misses, is usually surprised at its shortness.... He can often eliminate most of his errors by learning to spell no more than 40 or 50 words." Keep in mind that electronic spell checkers do not have any bearing on word choice. The wrong word correctly spelled is still the wrong word.

Words frequently misspelled in this course include: yield, specimen, temperature, Riehle, recommend, omission — to name just a few. The use of a word guide is strongly urged for those students with a spelling problem.