ENAE 464
Writing Handout

1. Technical Report Writing

There is no single prescribed format for a technical report. Many variations are possible. The following is a suggested set of guidelines which should be adequate for this course, and should also meet the needs of most technical report writing you are likely to encounter.

Before commencing your report, have clear in your mind who your reader is likely to be. It is best to assume that, in the case of technical reports, your reader is technically knowledgeable but does not have specific information concerning the work you undertook or the results you obtained. Do not assume your reader is your professor, who presumably knows more about this subject than you do, and therefore does not need clear and complete explanation of your work.

2. Components of A Technical Report

2.1 Letter of Transmittal

This is a brief letter accompanying a report indicating that the report is enclosed or attached. In some cases, the letter is put at the beginning of the report following the title page rather than on top of it. It simply is up to your preference whether to make the letter a part of your report by putting it behind the title page or to separate it from the main report by placing it on top of the title page. While it serves not much purpose other than officially turning the report over to the reader, it is a professional and courteous way to present the report.

In general, the letter should be addressed to the person or organization that requested the information contained in your report. For the purpose of this course, however, your letter can be addressed to the laboratory professor whose experiment you just have completed.

2.2 Title Page

The title page should include the following information: the title of the experiment; the name of the report writer (your name); if applicable, the names of the students who composed the group you worked with; the dates that you performed the experiment and that you are submitting the report; and your university, department, and course number. An example cover page is shown in the next page.

The title should be broadly informative but concise. A rule of thumb is that if it contains fewer than five words, it is probably insufficiently informative; if it cannot be accommodated on one line, it is probably too lengthy. For example, "Cantilevered Beam" gives the reader no idea as to what aspects of a cantilevered beam are covered. On the other hand, "Measuring the Deflection of a 1-inch Wide, 1/16-inch Thick, and 18-inch Long Cantilevered Aluminum Beam Subjected to a 1-lbf Static Force Loading and a Piezo-Electric Actuator Dynamic Loading in the Frequency Range Between 1 and 1000 Hz" is much too wordy. A reasonable compromise might be "Deflection Measurement of Cantilevered Beam Responding to Static and Dynamic Loading."

(Example Title Page)

University of Maryland
Department of Aerospace Engineering
ENAE 464

Deflection Measurement of Cantilevered Beam Responding to Static and Dynamic Loading

John J. Doe

Experiment Performed: February 4, 2010
Report Submitted: February 15, 2010

Group
A.B. Brown
J.J. Doe
B.W. Smith
C.F. Williams

2.3 Table of Contents

The table of contents is a typical list of the headings and subheadings of a report, shown together with the pages on which they start.

(Example)

CONTENTS

2.4 Abstract

The abstract should be on a separate page and should be of about 100~200 words in length. It is a concise statement of the nature of the report, which is capable of standing alone and informing the reader whether or not the contents of the report will be useful to him/ her. It should contain:

a. The objective of the investigation
b. A very brief, general description of the apparatus used
c. The types of experiments performed, with ranges of conditions if appropriate
d. A statement of the principal results
e. Major conclusions drawn from the results

Even though the abstract is placed first in the report, it is best written last, after you have fully comprehended and analyzed your results and conclusions. Remember that in many data bases and abstracting services, the only information provided to the reader is the Abstract, and the reader must decide on the basis of the Abstract alone whether the information contained in the report will be of sufficient value to warrant further examination.

2.5 Nomenclature

If you include a list of symbols, arrange them in alphabetical order, first the Roman letters, then the Greek letters. Definitions of subscripts and superscripts come last. It is permissible to use entries such as

k_n defined by Eqn. (5)

if the definition of k_n is a complicated expression.

2.6 Introduction

The introduction tells the reader what he/she needs to know in order to understand what you did and why you did it. It provides a general statement of the objectives, scope and any important specific features of the investigation. It outlines the experimental approach used, and provides the theoretical background necessary for understanding the experimental goals and approach. However, detailed discussion of these topics is reserved for later sections of the report. For example, only the principal results of a theoretical model need to be described; the detailed development of the model is better left to a separate section or an Appendix. If you feel that the theoretical considerations or background belong in the body of the report, it is best to present them in a separate section, which could follow the introduction.

2.7 Experimental Apparatus and Procedures

This section provides a succinct description of the apparatus, accompanied by a neat sketch of the apparatus or flow diagram. The instrumentation used is identified by name and model number. The variables that were controlled and the quantities that were measured are cited. The

operating technique is described in general terms, and mention should be made of any significant basic problems which arose during the experiment and what you did about them. If, in retrospect, the experiment might have better been carried out differently, this is a place to discuss the alternatives, although you might wish to save it for the discussion section. Calibration procedures should be described here, as well as data reduction and error analysis methods. However, these should be described in brief and general terms, with details relegated to Appendices. (See discussion on Appendices.)

Avoid narrative style of describing what you did: ("First we did this, then we did that... etc."). Likewise, omit trivialities, such as "The signal generator was first hooked up by a BNC cable to the voltmeter." It should be clear from your schematic of the experiment what the wiring was. You do not have to record every false step you took, or what parts you broke. Strive for conciseness and clarity in your exposition, but tell enough to enable an intelligent reader to reproduce your work.

2.8 Results

Present the significant experimental results preferably in graphical form or in tables. Discuss each figure or table, in numerical order, to establish the significance of the results presented. Illustrate with your graphs or tables how well your experimental goals were achieved. (Do not refer the reader to an Appendix or your project notebook for these figures or tables.) The data should be in reduced form, e.g., Reynolds number as opposed to flow-meter reading, so that the reader can interpret them in most general terms. Discuss the reproducibility of individual measurements, and how that reproducibility relates to scatter in the generalized experimental results. Consider systematic as well as random errors.

All of the results of the experiment that are to be referred to the Discussion and Conclusions section should be presented in the Results section. Keep in mind that this section is for the presentation of results; their discussion belongs in the next section.

2.9 Analysis and Discussion

Briefly describe how the results were evaluated and draw conclusions as needed for each analysis. Interpret the experimental results in terms of physical principles and the particular circumstances of the experiment, as presented in the Introduction. Discuss the reliability of the reduced data, as determined by your uncertainty analysis. The details of uncertainty analysis can be presented either in this section or in the Appendix. Compare the results with those expected on the basis of theory or empirical correlations, and discuss any deviations. Relate these deviations to their impact on the use of your results for the objectives set out in the Introduction.

2.10 Summary and Conclusions

Concisely describe the important findings, giving a brief statement of the conclusions that the experimental data support. Make any recommendations that are required to meet the objectives of your work. Do not introduce any new information in this section.

Including a summary before concluding remarks is optional. If you include a summary here, it is important to understand the differences between an abstract and a summary. The abstract goes at the beginning of the report, in the front matter, and represents the entire report to the reader or potential reader. A summary needs not stand alone or represent the entire report, but, rather, it serves to bring together the most important points that you want to highlight for the reader and have him/her remember.

2.11 References

There are several ways of citing references. One is to list the references in order in which they were referred to (usually by a superscript number or a number enclosed in square brackets [#]) in the report. An example of this is:

> "It can be shown by analyzing the Rankine-Hugoniot equations in a simplified system[3] that...,"

which you have written in the body of the report, will correspond to an entry in the Reference list,

> [3] Williams, F.A., "Combustion Theory," Benjamin/Cummings Publishing Co., Menlo Park, 1985, pp. 24-26.

An alternative scheme is to use the following format:

> "It can be shown by analyzing the Rankine-Hugoniot equations in a simplified system (Williams 1985) that...,"

which then will be cited in the reference list in alphabetical order without a numbered reference as

> Williams, F.A., "Combustion Theory," Benjamin/Cummings Publishing Co., Menlo Park, 1985, pp. 24-26.

If you cite two of Williams' works both published in 1985, then use 1985a and 1985b to designate them. One advantage of this latter method of referencing is that a reader familiar with the field may from the reference author's name and the date be able to identify the reference without looking at your reference list.

A short journal article may not require page numbers in the citation, though it is better to include them, but if you reference a book you must at least give the relevant chapter number if not the inclusive page numbers. Conference papers are usually referenced by the name and the location of the conference in addition to the identifying paper number assigned at the conference.

Refer to any technical journal for typical formats used in citing various references. In general, however, a reference format is journal-specific and varies considerably from journal to journal. Thus, you should choose your preferred format of listing your various references

(books, journal articles, conference papers and reports) and maintain a consistent style throughout the reference section.

2.12 Appendices

An appendix is an integral part of a completed report; consequently, the legibility and quality of reproduction should be comparable to that of the main body of the report. Hastily scribbled notes on odd sheets of paper and illegible or carelessly drawn graphs are unacceptable.

The appendices are the appropriate places for bulky material such as flow diagrams or particularly extensive tables of reduced data from which the graphs of the results section have been derived. Other material belonging in Appendices are lengthy derivations or detailed procedures which because of their length and/or complexity would impede the transfer of the main message of the report, and computer program code which would be of interest to only a few of the readers of the report. Inclusion of appendices is common but optional; in many reports one is not needed. Include only the material referred to in the report, with such references being direct, rather than via the Reference list. (For example, "See Appendix II for further details.") Raw experimental data should normally be kept in your laboratory notebook, particularly if it has been reduced to a more meaningful form. Also, sample calculations usually belong in the laboratory notebook rather than in an appendix, although in instances when they may be particularly instructive, they may be included.

Remember that both the main body of the report and the Appendices should be self-contained. You should not require the reader to refer to an Appendix in order to follow the exposition given in the main report, nor should you make an Appendix so cryptic that it is unintelligible if read separately from the report.

3. Notes on Tables, Figures, and Equations

All tables and figures must be referred to in the text; otherwise there is no need for them in the report. If only a few tables and figures are presented, it is desirable that they be interleaved with the textual material of the main report in the order that they are referred to. This takes a bit of organizing on the writer's part, but helps the reader to follow the text without flipping back and forth for the referred tables and/or figures. If many tables and figures are involved, you may instead insert them between the Reference list and the Appendices, placing all the tables first and then all the figures. All tables should be titled and numbered, and all figures should be numbered and captioned. Identify clearly what quantities have been tabulated in the rows and columns of your tables, and be sure to indicate all the units of measurement. Figure captions should be brief but sufficiently descriptive to provide enough information so that it is clear what is being presented. Ordinates and abscissas should be clearly labeled, and units of measurement indicated. Figures should be prepared by using computer graphics whenever possible. Many different types of graphics software and plotting applications are widely available for personal computers. If you don't have an access to such applications, prepare it on a good quality graph paper using a straight edge and French curves. Free hand sketches are not acceptable.

Each important or complex equation is to be numbered and presented on a separate line, but must constitute an integral part of a sentence. For example,

> "The natural frequencies of the beam subjected to the above boundary conditions are given by
>
> $$\omega_n = \left(k_n L\right)^2 \sqrt{\frac{EI}{mL^4}}, \qquad \text{n} = 1,2,...\text{N} \qquad (12)$$
>
> where ω is the circular frequency, k the wave number, L the beam length, E the modulus of elasticity, I the second moment of the beam cross-sectional area, and m the mass per unit length of the beam. The subscript n denotes the mode number."

(If you have provided a Nomenclature in your report, the definition of symbols in the text is not absolutely necessary, although it is helpful to the reader.) It is not correct to write "The natural frequencies of the beam subjected to the above boundary conditions are given by Equation (12)," and then display the equation. It might be helpful to you to mentally substitute the phrase "this equation" for the actual formula you display when you write and punctuate your sentences. If an equation is numbered, it must appear on a separate line. However, if a very simple relationship is used and not numbered, it can be incorporated in the text directly, as for example, "The voltage is given simply by V=IR."

University of Maryland
Department of Aerospace Engineering

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Student _____

Full Report Grading Template

Item	Maximum Points
Organization of Report and Cover Letter	10
Abstract	10
Introduction	10
Description of Materials, Instrumentation and Procedures	15
Data Reduction Procedures and Presentation of Results	15
Analysis and Discussion of Results	20
Summary and/or Conclusions	10
Spelling, Grammar and Style	10
Total	100