CIVE 3331 - ENVIRONMENTAL ENGINEERING

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Course Administration

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Teaching assistant contact information

The teaching assistant is Ms. Xin He. Her office is S3 (Basement of Engr. 1 building). Her e-mail

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The phone in the office she uses is broken, so e-mail is the best way to contact her. She will be grading the exercises and preparing solutions as the semester progresses.

Grading

The course grade is determined by performance on exercises (homework), examinations, attendance, and participation in lecture discussions. The provisional weighting for each of these components is 20% exercises, 5% attendance and participation; and 75% examinations. There will be at least one mid-term examination and a final examination. There may be quizzes administered in class without advance notice as determined by the instructor. Typically these quizzes will be identical to previously assigned exercises, or examples worked in class.

The grade is calculated using the above weighting scheme, then normalized by the weighted score of the best performing student. These normalized scores are then converted to a 4.00 scale and the letter grade is assigned using the same demarcation values as used in the UH GPA calculations.

Academic Honesty Policy

The academic honesty policy at the University of Houston is included in the reading materials for this lecture. For this course the relevant sections pertain to the representation of other peoples work as your own and cheating on examinations and homework exercises. Read about how to reference materials so that you do not unintentionally claim credit for other peoples work. As for cheating on homework and examinations here is what is expected in this class.

Homework (exercises) is expected to be your own work. I expect and encourage you to work together on the exercises because I believe that it improves your understanding of the material, but I do not condone flat out copying. The homework is a significant component of the grade and learning material, so the incentive to cheat might be great, but it is not worth it because you will be detected on the examination(s).

The examinations are a solo endeavor. In my class the examinations are open book, notes, laptops, whatever. What I forbid is communication with other people on or about the examination. In a practical sense, this means that you should come to examination prepared to work the exam without help from other people. I may move you around the exam room to reduce the potential for accidentally looking at others papers while you are pondering a problem.

Learning approach.

There are many approaches to learning. I find that working through simple and complex assignments helps one learn the material better than any other approach that is feasible within the confines of a lecture-only course. Thus the exercises are extremely important. You should come to each class having completed to the best of your ability the exercises assigned for the lecture. You may be asked to present your solution to these exercises as part of the class. This requirement is intended to provide training in the oral presentation of engineering work products.

Using the Library.

Using the Internet.

Documentation of work

Engineering Reports

Most engineering studies result in a report and/or drawings. The particular format will vary depending on client, audience, etc. This lecture discusses in general terms a useful format as well as graphics convention guidelines that will help in report preparation. You will learn methods to prepare construction and engineering drawings in other courses.

As a starting point the following format is suggested for exercises where a report is required.

Title Page – Lists the title of the report, the author(s), and date of the report.

Introduction – ALWAYS WRITTEN LAST! The introduction provides background to the problem, explains the general approach to solving the problem, and summarizes the conclusions. The introduction is not detailed, but it should contain enough explanation so that if it is the only section that the reader sees, the reader can describe the problem and findings of the exercise.

Problem Statement – Clearly state the problem to be solved. Include description of data supplied with the problem and data that that are estimated (as opposed to measured).

Method of Solution – Describe in detail how you will obtain a solution.

Method Testing – Describe the testing of the solution method. In this section you test the model against known solutions to convince the reader that the model is capable of solving problems similar to the stated problem.

Results – Present results of the solution method applied to the specific problem. This section will likely contain many graphical and tabular results. Tables and graphs (and maps and drawings) must have meaningful captions. Tables are captioned at the top of the table. Figures (graphs) are captioned at the bottom of the figure.

In the text portion the "call-out" to the table or figure should be detailed. It is ***not*** sufficient to write, "the results shown (see Figure 1) clearly indicate that the scheme will fail." As a minimal criticism, the quoted section is "rude" to the reader "(see Figure 1)", the results are not explained (What are we looking at in Figure 1?), and the reason that the results indicate failure are not explained. Adherence to an effective communication style is very difficult and takes years of practice – even then one does not get it correct every time.

Conclusion – This section synthesizes the results and makes conclusions based on the results presented.

References – List all references explicitly cited in the body of the report.

Appendix – Supporting materials, data, and computer printouts etc. are supplied so that a reader could (in principle) reproduce your results.

Exercise Reports (for this class)

You are expected to typeset all exercises in this class. These typeset exercises and your solutions will become part of the portfolio that will be used to determine your course grade as well as document professional development in this class.

The engineering report format presented is unnecessarily detailed for most the exercises in this class. Instead an abbreviated format is suggested. The format is:

Problem Statement - Clearly state/restate the problem to be solved. Include description of data supplied with the problem and data that that are estimated (as opposed to measured).

Solution Approach - Describe in detail how you will obtain a solution. In the context of a typical engineering mechanics problem, you will state the governing principles and equations that will be used. You will list known values and data that will be used (along with reference to where the data came from). Usually a sketch of the system to be analyzed appears in this section.

Analysis/Design/Results – Present the logical steps to go from the known values to the solution for the specific problem. In this section you will present the algebraic manipulations and arithmetic steps that are used to obtain a solution to the problem. The result/answer is presented here, with the correct (hopefully!) units and appropriate number of significant digits for the problem.

Recall that the purpose of this format is professional development – to get you used to writing in clear detail your thinking process and solution technique. It is understood that you will in essence solve each problem twice – once in handwritten format, and again as you summarize your efforts in a compact form that can be typeset efficiently. It is OK to include your handwritten notes as an appendix to each of your typeset solutions, but the typeset solutions are expected and required.

How to include references in your reports/exercises.

The "call-out" in the text body to a references will typically be by last name and date. For example "...respect to the use of the commons for grazing livestock (Hardin, 1968)." The citation in the reference list would be by author(s) last name, date, title, publication name, pages. The example corresponding to the call out is

Hardin, G., 1968. "The tragedy of the commons." Science, **162**, pp. 1243-1248.

References to books (textbooks too) is similar. An example is

Masters, G.M., 1996. Introduction to Environmental Engineering and Science, 2nd Ed., Prentice Hall, New Jersey, 651p.

In these two examples the publication is underlined (a textbook is a publication); the article is typically enclosed in quotations. The bold number in the first reference is the volume or issue number. Many publications have a volume and issue number. The actual pages of the article are shown in the first reference, while the total number of pages of the book is shown in the second reference.

A printed copy of the web page must accompany references to Internet URLs. This requirement is because web sites change hosts (the server where the data are stored) frequently and the URLs become obsolete quickly.

Graphics Standards for Drawings

Drawings and sketches are used to visually explain to the reader spatial relationships of items involved in the analysis. Engineering-for-profit reports usually contain a lot of drawing information that is not appropriate for academic-type work. Drawings that are not relevant to the problem should not be included. Again it takes some experience to determine relevance – it is best to err on the side of too few drawings than too many (my opinion).

Copies of other people's drawings and sketches should contain a citation to the original author and reference (and this reference will also appear in the reference list).

Drawings should be high-quality mechanical drawings and not the usual garbage we all sketch when originally thinking about a problem. When dimensions are important, the drawings should be properly scaled, or the lack of scale clearly indicated. Coordinate system(s) should appear on the drawings. Essentially the drawings in many cases should contain most of the features of a free-body-diagram that is required in engineering mechanics analysis.

Drawings are captioned below the drawing. The captions should be meaningful.

Graphics standards for drawing a chart/graph.

Graphs are used to present data that are too extensive to make sense from if they are presented in a table. If a graph is presented, the data used to generate the graph should also be presented in a table (or at least should be able to be presented in a table). In technical reports one usually presents the tabular results in an appendix and the graphical representation in the report body.

Vertical and horizontal axis must be labeled with the type of data being plotted and the units! When plotting real data and model results, real data are always plotted as markers and model results are plotted as curves. If one deviates from this convention, the plot legend should clearly indicate which markers are data and which are model results. Real data should never be joined with lines unless there is a very good reason. Most plotting programs default to drawing lines, so the analyst needs to override this default.

In addition to these "format" issues the writer has an obligation to adhere to a philosophy of honest presentation of results. Consider the following calibration exercise as an example. Table 1 is a tabulation of calibration measurements for a flow meter. While the table is useful, and necessary, alone it is a poor communication tool.

The table lists data in several columns related to flow meter measurements. The notes at the bottom of the table are crucial in interpreting the data, but this table can probably stand alone. Obviously some text description would be in order for the table to be really useful. The same information in the table can be displayed on a graph.

Table 1. Flow meter calibration data

Date	W (ft)	D (feet)	Q (cfs)	V (ft/sec)	v (counts)	VM (ft/sec)
1/3/96	3.28	1.100	0.646	0.179	127	0.173
1/3/96	3.28	1.100	0.646	0.179	147	0.190
1/3/96	3.28	1.120	0.847	0.231	230	0.259
1/3/96	3.28	0.560	0.667	0.363	397	0.399
1/3/96	3.28	0.360	0.523	0.443	515	0.498
1/3/96	3.28	0.720	1.252	0.530	654	0.614
1/4/96	3.28	0.340	2.000	1.793	2280	1.977
1/4/96	3.28	0.280	1.710	1.862	2189	1.901
1/4/96	3.28	0.120	0.667	1.695	1430	1.265
1/4/96	3.28	0.570	0.471	0.252	185	0.221
1/4/96	3.28	0.490	0.489	0.304	246	0.273
1/4/96	3.28	0.400	0.710	0.541	561	0.536
1/4/96	3.28	0.840	1.030	0.374	420	0.418
1/4/96	3.28	1.320	0.818	0.189	172	0.211

Notes:
W = Channel width in feet. Measured with tape.
D = Depth of flow in feet. Measured with staff gage.
Q = Discharge in cubic feet per second. Measure with Parshall Flume
V = Flow velocity calculated from Q,D and channel width in rectangular channel.
v = Flow reading on MJP flow meter (counts/minute)
q = Discharge calculated from v,D and channel width in rectangular channel
VM = Velocity calculated from flow meter reading (using calibration formula)

The notes explain the contents of the column but are not intended to explain the whole procedure used to obtain the data in the table. If the date information are not important the table would probably be sorted by increasing velocity value.

Table 2 is the same data sorted by increasing velocity. In this table the reader can see that the velocity and "counts" are related – as counts increases so does velocity. Even with the sorting, the type of relationship is not obvious. To illustrate relationships is the main purpose of graphs.

Table 2. Flow meter calibration data (sorted)

Date	W (ft)	D (feet)	Q (cfs)	V (ft/sec)	v (counts)	VM (ft/sec)
1/3/96	3.28	1.100	0.646	0.179	127	0.173
1/3/96	3.28	1.100	0.646	0.179	147	0.190
1/4/96	3.28	1.320	0.818	0.189	172	0.211

1/3/96	3.28	1.120	0.847	0.231	230	0.259
1/4/96	3.28	0.570	0.471	0.252	185	0.221
1/4/96	3.28	0.490	0.489	0.304	246	0.273
1/3/96	3.28	0.560	0.667	0.363	397	0.399
1/4/96	3.28	0.840	1.030	0.374	420	0.418
1/3/96	3.28	0.360	0.523	0.443	515	0.498
1/3/96	3.28	0.720	1.252	0.530	654	0.614
1/4/96	3.28	0.400	0.710	0.541	561	0.536
1/4/96	3.28	0.120	0.667	1.695	1430	1.265
1/4/96	3.28	0.340	2.000	1.793	2280	1.977
1/4/96	3.28	0.280	1.710	1.862	2189	1.901

Notes:
W = Channel width in feet. Measured with tape.
D = Depth of flow in feet. Measured with staff gage.
Q = Discharge in cubic feet per second. Measure with Parshall Flume
V = Flow velocity calculated from Q,D and channel width in rectangular channel.
v = Flow reading on MJP flow meter (counts/minute)
q = Discharge calculated from v,D and channel width in rectangular channel
VM = Velocity calculated from flow meter reading (using calibration formula)

Figure 1 is a plot of the measured "counts" on a flow meter and measured velocity in a channel. The plot also displays a line that is a calculated velocity, presumably based on measured counts. Typically the predictor variable is always plotted on the horizontal axis (as it is in this example.)

As presented the chart is not bad. A reader with a flow meter could operate the meter, read the "counts per minute" from the meter and use the calculated velocity curve to infer the actual velocity in their flow field. Immediately one observes that the audience greatly influences how a graph is presented.

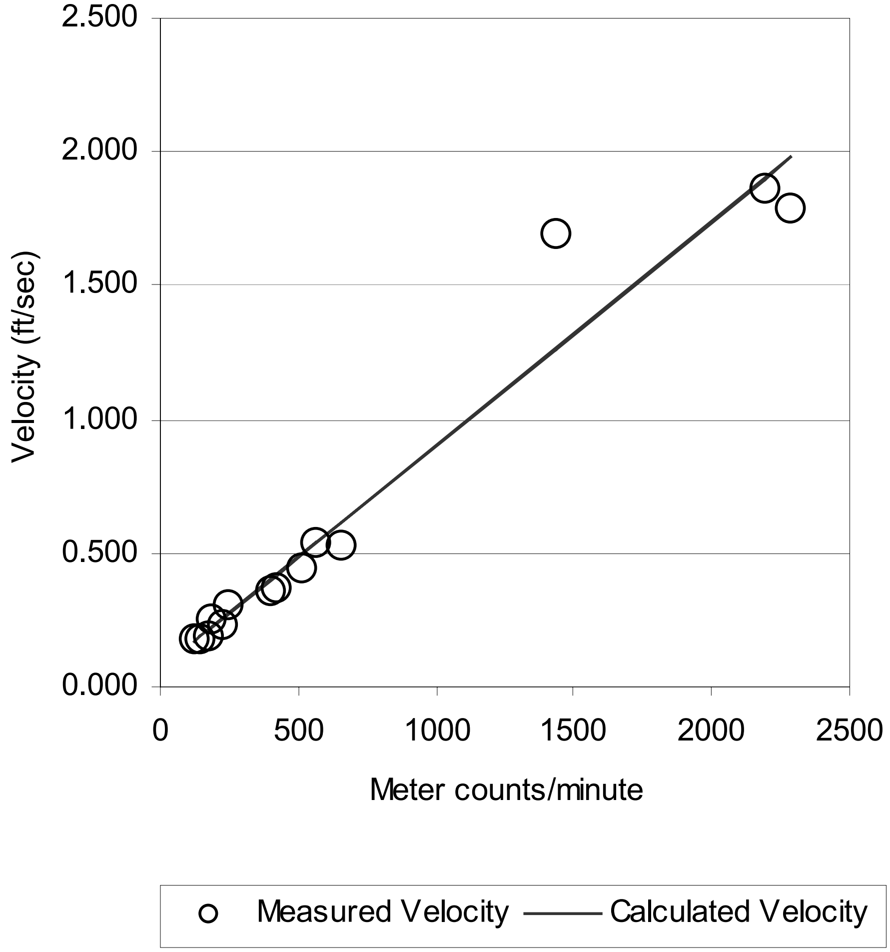

Figure #.# Flow Meter Calibration MJP FM001

Figure 1. Example of "Fair" Graph

One can improve the graph by improving the caption to include the regression equation. Figure 2 is such an improved graph. The solid line is now labeled as a calibration curve, and the regression equation is shown on the graph. Any more information is probably overkill.

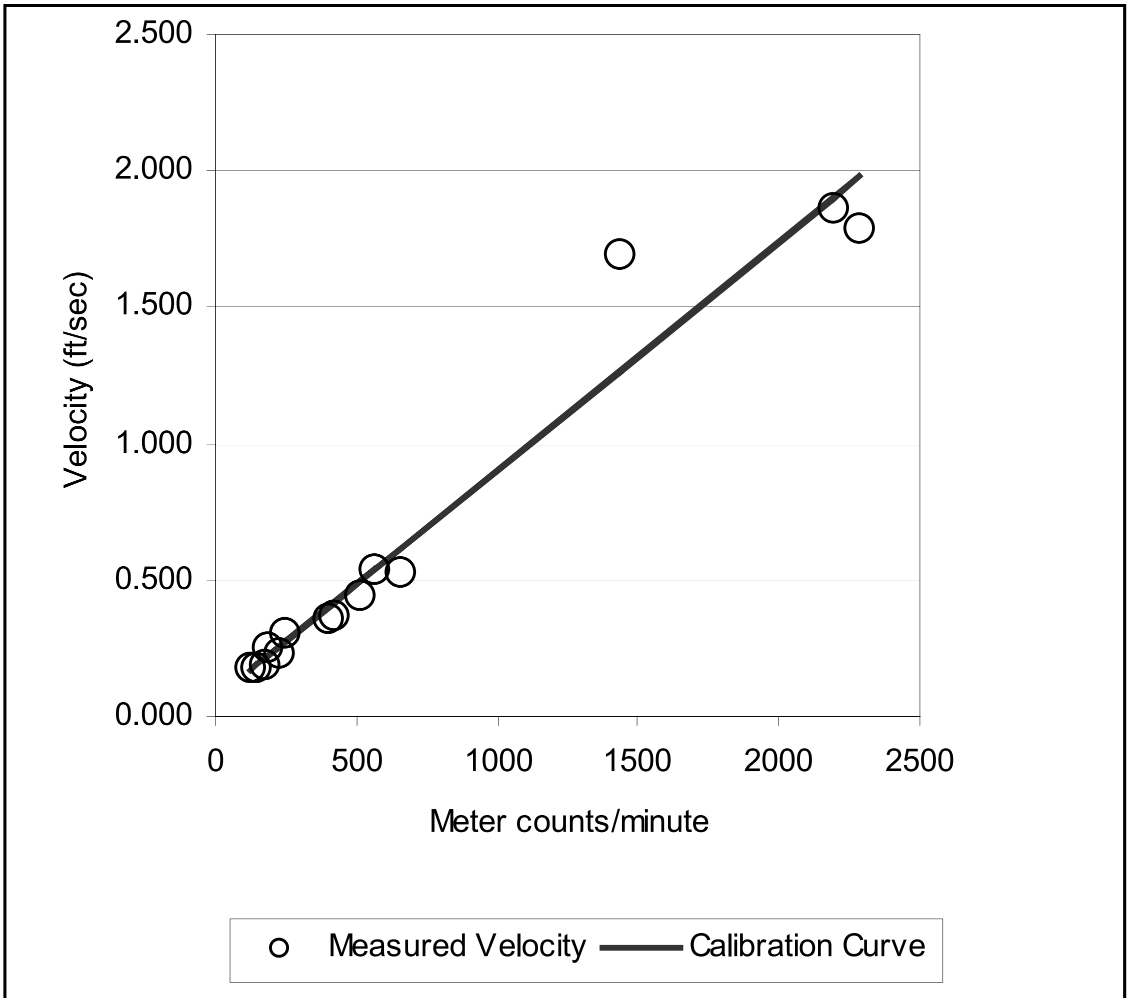

Figure #.# Flow Meter Calibration MJP FM001
Velocity = 0.00083*(counts/minute)+0.0664

Figure 2. Example of "Good" Graph

These examples are intended to illustrate the kind of thinking that should go into a graph. In many situations the guidelines presented work fine, but there will be circumstances when you will have to depart from the guidelines.

These guidelines are my preference; your professors, supervisors, and/or companies may have different conventions that they expect you to use (remember the audience). Obviously, use the guidelines required for your particular line of work.

Regardless of audience all graphs should have the following:

1. *Caption (Figure ##.## What is this a graph of?)*
2. *Axis are labeled – units of measure are in labels*
3. *Different relationships use different markers/lines*
4. *Lines must be labeled or appear in a legend*
5. *Data are shown with markers (always)*
6. *Models/calculations are usually shown with lines, but markers are OK.*
7. *Predictor variables are almost always plotted on the horizontal axis.*

Tools: EXCEL has good plotting tools as well as analysis tools. I prefer EXCEL in most cases because it forces the analyst to use great care and to understand his/her data. The chart in this lecture was prepared using EXCEL. When you have uncertain information to present, EXCEL is harder to use as a presentation tool, but not impossible.

Graphics standards for creating a table/list.

Tabulations are presented in a table. A table is usually a list of related data. Some tables are used to directly show relationships, others are simply recounts of data. Tables are captioned at the top of the table. The two tables in the section on graphs serve as basic examples.

Graphics standards for creating maps, contour, and vector plots.

Maps often appear in reports to help the reader understand where (in the world) the problem is located. Maps are also used to display numerical information that has spatial relationships. Maps are captioned as Figures. Maps should always be presented with their scale (1:20,000) or have a distance scale shown directly on the map. Generally a scale directly on the map is preferred because spatial relationships are properly preserved if the report is subsequently copied and enlarged or reduced during copying. By convention, North is always up (top) unless directly indicated on the map, but most people include a North arrow anyway. Some maps have vertical/horizontal distortion – such distortion must be clearly indicated.

For the most part contour plots are treated as maps. The contour interval must be stated in the caption, and at least one contour line must be labeled. Contour axes are usually some coordinate system and this relationship should be indicated. Vector plots are also treated as a map. Most vector plots use vector length to indicate magnitude, so you should always provide a reference vector in the scale or legend.

Tools: SURFER is an excellent contouring tool. It is not free, but it is worth its cost. EXCEL has limited contouring capability and is not very useful. There are some public domain tools available – check the web.

Introduction to the Engineering Profession

ABET and program accreditation.

ABET is one of many accreditation bodies for professional education in the USA. Medical doctors, lawyers, engineers, electricians, etc. are all licensed to practice their profession and all receive educations from programs that are accredited by their various professional oversight board. The purpose of a license is to guarantee to the public that the licensee is minimally competent to perform the profession for which he/she is licensed. An accreditation body performs the same kind of quality assurance function for an education/training program. In this case the purpose of accreditation is to guarantee to a licensing agency (the government) that the training program (your UH engineering degree) meets a minimum acceptable standard to the profession that the graduates of that program have been educated sufficiently to practice the profession.

If any part of the system fails (accreditation or licensure) then the profession's reputation is harmed, and in the case of most professions, the public may be harmed by incompetent professional behavior. As a student your concern should be that the program you are in is ABET accredited (all UH engineering programs are accredited at the undergraduate degree level) and that the program keeps its accreditation. One of the recent criterion for accreditation is student commitment and quality, thus you are part of the process. The principal way you can contribute is to treat your course work as a professional training program and the materials you produce (homework, reports, examinations) as an engineering product.

License as a professional engineer.

To practice engineering in the United States you will eventually have to be licensed. The state where you practice issues the license and administers the licensing procedure. Although the requirements of each state are different, there is sufficient commonality that any states license is usually accepted as sufficient evidence for issuance of license in another state (California being a notable exception).

Excerpts from the State of Texas Requirements appear below"

Section 12. GENERAL REQUIREMENTS FOR LICENSURE. (a) The following shall be considered as minimum evidence satisfactory to the Board that the applicant is qualified for licensure as a professional engineer:

(1) **graduation from an approved curriculum in engineering** that is approved by the Board as of satisfactory standing, **passage of the examination** requirements prescribed by the Board, and a specific **record of an additional four (4) years** or more of active practice in engineering work, of a character satisfactory to the Board, indicating that the applicant is competent to be placed in responsible charge of such work; or

(2) **graduation from an engineering or related science curriculum at a recognized institution of higher education**, other than a curriculum approved by the Board under Subdivision (1) of this subsection, **passage of the examination** requirements prescribed by the Board, and a specific **record of at least eight (8) years** of active practice in engineering work of a character satisfactory to the Board and indicating that the applicant is competent to be placed in responsible charge of such work.

Importance of attending an ABET accredited program.

From the highlighted sections of the Texas act, you can see that there are 3 (actually 4) requirements.

Graduation from an engineering program, passing the FE(EIT) exam, passing the P&P exam, and 4 years documented experience. Most other states have similar requirements. Observe that the board considers an ABET accredited program de-facto “approved” and only requires 4 years experience. If a program is not ABET approved, you will need 8 years experience before you can obtain a PE licensed – a pretty severe penalty if you don’t attend an ABET approved program. The specific accrediting bodies are stated in the actual law governing engineering practice in Texas (a reading assignment for you).

Documentation of your engineering experience.

The key tool the board uses is the applicants SER (supplementary experience record). Examples are on the Texas Board of Professional Engineers website. My advice to students is to maintain a professional journal (it could simply be notations on a calendar) of what engineering work you performed when, who was your supervisor(s), and what is their address. You will need to be able to contact these people for references several years later. If you burn a bridge, so be it – simply be factual in the SER and the board will usually accept that component of your experience.

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