## Lab Report #2 – Bending of a Channel - Comments

In order to mark the reports as quickly as possible, detailed comments were not put on each assignment. It is left to students to read this set of group comments, and refer it to their own submissions.

***Report Format***

A key point about a report is that it is a proper document, not a set of unrelated paragraphs, figures and tables - that is why a sample report and template was provided. All graphs, figures and tables should be numbered and referred to in the text. Eg “The stress strain curve for steel is shown in Figure 2 and the results for all specimens are summarised in Table 4.”

Hence if “text required” or “report format” has been written on your report, this is what is being referred to. Some students just had a large number of unrelated diagrams and tables. The “results” section in many reports often was just a BMD, a few graphs, and a few tables with no explanatory text at all. The author should always ask himself/herself “Would someone else understand what I am doing”.

It is hoped that all students looked at the sample report on the Internet, and noted that the figures and diagrams are incorporated into and referred to by the text. A fully “integrated” document was not necessarily expected, since it is recognised that some student are not very familiar with Word & Excel, and some parts were hand written, and Excel used for graphs etc, but there still needs to be some explanatory text. While written sketches are acceptable, it is expected that they are neat – for example use a ruler for straight lines.

A key aim is to communicate your results to someone else - make sure they can be clearly understood. For example, many students referred to the vibrating floor, but did not explain it in sufficient detail. While every student in the class would have understood this vibration of the floor, as everyone experienced it, would have an engineering student from UNSW appreciated the significance of this, and how difficult it made reading the dial gauges.

***Abstract***

In one paragraph, the abstract should communicate the aim of the report/experiment, what was done and how it was done, and what were the main conclusion/results.

As an example, “This report outlines bending tests on a channel section to examine the elastic deflections. The experimental results are compared with the theoretical predictions.” It is appropriate to include more – what were the results? “The experimental behaviour was linear elastic, and that the predicted results were, on average, 2 % less than those observed experimentally”. Many students missed out referring to the results – eg “The three I values are compared” or “The three I values were close.”. What does “close” mean?

***Method***

Note this is a report, not a set of instructions. Therefore it is not appropriate to repeat the instructions from the lab sheet. The “method” section should be a brief description of what was done – in enough detail for someone to repeat the test. Hence the description should be written in the past tense. A certain level of competency in the reader can be assumed – hence there is no need to give diagrams or explain how to read the strain gauge or the micrometer. It is sufficient to write “Cross-section dimensions were measured by micrometer and the midpsan deflection was measured by a dial gauge”.

***First Person etc***
Rather than "we placed the steel in the machine", it is better to write "The steel was placed in the machine". It was encouraging to see a significant decrease in the use of first person compared to report 1. Please continue this for the rest of your report writing life!

***Tense***
Tense refers to past, present or future tense. The experiment was done several weeks ago – ie in the past. Hence any reference to the experimental method should be in the past tense: "The weights *were* placed on the beam" rather than "the weights *are* placed on the beam".

Discussion and analysis of the results requires thought about tenses. Consider the following examples:

1. Figure 1 shows that the experimental deflections are 1% higher than the theoretical deflections.
2. Figure 1 showed that the experimental deflections are 1% higher than the theoretical deflections.
3. Figure 1 shows that the experimental deflections were 1% higher than the theoretical deflections.
4. Figure 1 showed that the experimental deflections were 1% higher than the theoretical deflections.

When referring to Figure 1 it is better to use the present test "shows", as Figure 1 is indicating something about the results right now, in the present, as we are reading the report today. Visit the *WriteSite* webpage module on tenses at http://writesite.elearn.usyd.edu.au/m1/m1u4/ for some useful tips on tenses.

A good rule of thumb is to use the past tense when referring to your experiments or results ("The beam was bent"), but use present tense to refer to things that are facts that are widely accepted to be true ("Young's modulus of steel is 200000 MPa"). http://en.wikipedia.org/wiki/Scientific_writing has some useful tips.

***Significant Figures***
There was a definite improvement in the use of sig figs – good, but some students still insist on using too many significant figures, particularly when cutting and pasting tables from Excel. Please use the "format cells" option within Excel to specify the number of decimal places before cutting and pasting. A minor point on that though, when there is a table of numbers, it is better to use the same number of sig figs in each, to make them easier to compare, even if the trailing number is 0.

eg

| Load (kN) |
|---|
| 2.3 |
| 3 |
| 4 |
| 5.67 |

should be replaced by

| Load (kN) |
|---|
| 2.30 |
| 3.00 |
| 4.00 |
| 5.67 |

Note in graphs, it is possible to get Excel to limit the number of significant figures. For example, the graph of load vs deflection (load went to 220 N), there should be no decimal places in those numbers.

There was also an example when not enough significant figures were used – when getting Excel to determine the line of best fit, there were a number of students who used 1 dig fig only, and hence obtained that $EI$ = 2E10, when the correct slope was about 1.75E10 $Nmm^2$ (note the slope of a line has units!).

***Units***
An improvement, but some students still put insufficient units on their work.

***Comparing results***
The key aim of the experiments was to compare experimental results with various predictions. Hence the most important parts of the report are the tables and graphs which compare experiment to theory, and any explanatory text. Difference should be expressed as %. Eg “the I values differed by 2.7 x $10^6$ $mm^4$” or “ I was a little bit higher” has no real meaning. It is much better to write something like “on average the I values differed by 3.1 %”.

In Exp 2, students were asked to compare 3 sets of strain values. The best way would be to put all 3 values in a table next to each other, or via a graph, rather than in 3 sets of different tables on different pages. Remember, one task of the author is to make it easy for the reader to understand the results.

There are some other good ways to compare numbers – via a graph (but also include some text comment about the magnitude of the difference. In a table, one could tabulate “% difference” or have an additional column with a ratio of values “$v_{experimental}/v_{predicted}$)

***Error Analysis*** ***This section is not valid for the 2009 report, but I attach the comments from previous years for your information***
Only a small number of students fully appreciated what an error analysis does. Everyone can appreciate that the ruler may say 1 m, but that the true distance maybe 1 m +- 5 mm, depending on how precise the ruler is. An error analysis combines the various errors in all the inputs into a result, to get the error associated with that result. Hence the strains calculated might be 100 +- 5 microstrain. If the results being compared fall into that range, then there is a reasonable comparison.

There were many examples where the student's “theoretical” result was many times different to the measured result, and the student wrote that this could be explained by errors. Well that is almost true - an error in the mathematics! Eg it was mentioned several times that the dial gauge may not have been straight. Fair enough, but think if the gauge is 5 degrees off vertical then the gauge is measuring (1 / cos5) times the actual displacement, which is less than a 0.4 % error, so that cannot explain it. Similarly, while the floor was vibrating due to machinery downstairs, but the amount of vibration was quite small compared to the magnitude of the readings.

***Second Moment of Area***
Second moment of area is a geometric property of a cross-section, so $I_{calc}$ (based on the true measured dimensions) is the true *I* value. $I_{nom}$ is based on the nominal dimensions which might be 0.1 mm different to the "real" dimensions. $I_{exp}$ is not going to be the best answer as there are many assumptions built into the theory upon which the calculations were based.

***Self-weight or beam overhang***
All measurements are zeroed with respect to the deflected shape when the experiment commenced. Deflection due to self weight or the overhang was present when the zero readings were taken, hence all values observed are caused by the weights only and not affected by self weight.

Many students listed the self-weight as one of the factor ignored in the calculations which could explain the discrepancies between experimental and theoretical results. The same students few paragraphs later stated that the self-weight did not affect the experiment. Argumentation has to be logical in your report.

***Equations***
Most of the students had the equations correct for the bending moment, however sometimes the value of the maximum bending moment was incorrect. It is a shame that with a correct equation some students did not calculate the correct moment at one point. Double check the calculation and be consistent.

***Conclusions***
Be careful to ensure that the conclusion contains statements that which have been shown by the results.

Eg the results could not show that strain was proportional to the distance from the neutral axis, since only one position was considered. The only way to have shown this was to have had various strain gauges at different distance from the NA. It was possible to prove that the moment was proportional to the strain, since there were 5 sets of moment - strain data to compare.

There was a definite improvement from the first report, which is good, however it was disappointing that there were a small proportion of students who had not paid much attention to the guidelines given or the feedback from the previous report. For those that did pay attention – well done. Report writing is a very important skill that all professionals use and develop over their careers. Start working on it early, and get a head start on colleagues (ie competitors for promotion).

The basic marking scheme was that 6/10 (3/5) was given for a satisfactory report that addressed nearly all the issues and presented the results in a reasonable manner. Marks above 6/10 (3/5) indicate a higher level of presentation, analysis of the results or insight in the discussion. Marks less than 6/10 (3/5) indicate a report that was below the expectations from a second year engineering student – either by poor presentation, wrong results, or not doing all the required parts of the report. A mark less than 5/10 (2½/5) indicates that you need to make some significant effort to improve your report writing. You may wish to speak to me about it after reviewing the instructions given prior to the lab session.

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