Faculty of Engineering
Final Year Project

Writing the Final Report

These items form a general guide based on guidelines provided by various Engineering departments. While the information contained is generally applicable to Final Year Project Reports in Mechanical, Civil, Materials and Chemical Engineering, the emphasis placed on each item varies between departments, and some may have slightly different requirements. Students should refer to their own department’s current guidelines, or ask their supervisors, for more specific information.

Your supervisor is your primary authority in all matters related to the project and the report.

Purposes of the Final Report

• To present a clear, logical report of your completed research project
• To establish the outcomes of the project
• To demonstrate your ability to conduct and report a research, design, or industry project

The Final Report is the culmination of a semester or a year’s work. You have probably encountered various challenges or set-backs during the course of the project, and you might not have achieved exactly what you had hoped; however, this is your chance to present your work in a professional manner, acknowledging limitations, but highlighting your achievement.

Getting Started

Begin by reviewing your motivation and aims:
• To what extent have you achieved your aim/s and objective/s?
• What is the outcome of your project?
  (design/model/extension/verification/adaptation/identification/analysis/evaluation of…)
• Is it what you expected?
• If not, what were the limitations, constraints or problems?
• How could they be avoided or overcome in future?

Plan carefully:
• Allow much more time than you expect to need
• Expect to write several drafts
• Draw up a detailed point-form plan before beginning the first draft
• Write with second marker (where applicable) in mind
Plan each section in detail before you begin writing. This can be hard work, but it will help you identify structural problems such as repetition or gaps, and save you hours wasted in rewriting.

Sample plan for an Introduction

**Introduction:**
Offshore engineering (eg: oil rigs): **structures affected by water movement** eg tides, currents (+ weather)
**Safety** a priority - need to **test** new materials & designs - impractical in situ → use **model**

**Wave flume:** = 2 dimensional test facility
- replicates coast, ocean, harbour environments
- generates regular/irregular waves
- models:
  - wave kinematics,
  - wave propagation & breaking
  - linear & non-linear wave mechanics

**Problem:** **Monash flume:** 85mLx2.2Wx4D
30 y old → maintenance $ high → **need new flume**

**Aim:** to design a flume
**Criteria:** maintenance cost low/more work area/sturdy construction/ portable
→ Balance maintenance cost/weight/strength/size

**Structure:** Review wave flume technology & testing procedures/method/design

Note how the writer begins by setting the broad context (structures affected by water movement) and guides the reader step by step (via safety – testing – hazard – model) to the topic (wave flumes), then to the specific problem (Monash needs a new wave flume) and aim of the project (to design one). This thematic ‘linking’ should be clear in your plan before you begin writing. To check, try talking through your plan aloud. If you can’t make it “flow”, you probably need to revise your plan.

**Structuring the report**
There is no ‘correct’ way to structure the body of the report which contains your original work. The essential point is to organize your report so that it develops logically for the reader. This will not necessarily be the order in which you conducted the work.

**Use the following questions to check that you are on track:**
- Do the sections, as organized, present your project in a logical progression?
- Are there any very short or very long sections or sub-sections?
- Is it clear what is background and what is your original work?
- Do section headings reflect the actual content?

**Compare the two structures in the sample Contents pages below. Note how the main section headings in Sample 1 could belong to any experimental project, while those in Sample 2 clearly reflect the topic under investigation.**
Sections in the Final Report:

**Introduction**
The Introduction will have a slightly different focus to that in your Project Proposal or Progress Report. It should perform the following **functions**:

- Introduce the topic in context
- Explain the motivation for the project
- Clearly state the project aims and scope
- Outline the report structure

**Note:** Do not be concerned that the Introduction may include, in highly summarized form, information which also appears in other parts of your report. This is normal, as the function of the Introduction is to give the reader an overview of the ‘what’ and ‘why’ of the project. The reader will expect these themes to be developed in much greater detail where appropriate, especially in the literature review.
Introduction

In offshore engineering applications such as oil rigs, structures are subject to the effects of constant water movement in the form of waves, tides and currents, the impact of which can be aggravated by high winds and torrential rain. Safety is a priority in such environments; therefore, new materials and designs must undergo rigorous testing before implementation. However, the hazards of the environment render in situ testing impractical, so preliminary testing is conducted by modeling in a controlled environment.

A wave flume is a two-dimensional test facility which can replicate coastal, ocean, or harbour environments, generate regular and irregular wave patterns (Chiu et al. 2004), and model wave kinematics, wave propagation and breaking, and linear and non-linear wave mechanics (Lee & Palmer 2001). The Monash University wave flume was a state-of-the-art facility when constructed in the 1970s (Monash University 2007). Since then it has been in almost continuous use for both teaching and research purposes. As it ages, maintenance costs are becoming prohibitive, and it has been decided to replace the existing flume.

The aim of this project is to design a new wave flume with lower operating and maintenance costs, and a larger work area than the current flume. While a similarly sturdy construction is required, the new flume must also be portable so that it can be lent or hired out to other institutions.

This report presents a design for the new Monash wave flume. The design is based on findings from a review of the recent literature on wave flume technology and testing procedures, presented in the following sections. A description of the design process and detailed presentation of the final design follow. The report finishes with a discussion of the design constraints and suggestions for further improvement.

Note: This Introduction is intended as an illustration of the features required; it is not intended as a model of appropriate length. Your Introduction may be shorter or longer, depending on the type of project and the amount of detail necessary to explain the background to your project.

Review of the literature

In most cases your literature review will have continued to evolve as you read more and as your understanding of the theory, technology or previous studies develops along with the progress of your project work. You may need to add, expand or delete certain topics, or rewrite some parts in response to a change in direction or emphasis in your project. It is important to make sure that the content of your literature review is still all relevant to your project and that it still provides readers with the background information necessary to understand your project by:

- describing the current state of knowledge and/or technology in the field
- pointing out the gap in knowledge or technology which your project will fill
- introducing the theory, techniques, approaches, models, hypotheses or processes which underpin your work
Organisational structure
You will also need to check that the literature review is structured in the most logical way. Common structures include:

- Remote to recent
- General to specific
- Chronological
- Thematic

Look at the following literature review excerpts. Which organizational structures are represented?

a. From a literature review investigating the characteristics of vortex breakdown

Definitions
Spohn et al. (1998) compared flow and breakdown conditions with rigid cover and free surface in a confined flow generated by a rotating disc. They claim that asymmetric separation occurs on the cylinder wall, and that the bubble is an open structure, axisymmetric on the upstream side and asymmetric on the...

In contrast, Hourigan and Thompson (2001) argue that the breakdown bubble is in fact axisymmetric throughout. They claim that Spohn et al.'s findings are due to inaccuracies in their visualization technique... Thus, flow visualization techniques such as dye and electrostatic precipitation can be misleading....

b. From a literature review investigating structural health monitoring

Ultrasonic testing
Ultrasonic inspection uses high frequency sound waves to detect cracks in surface and subsurface. The wave travels along the structure and is reflected in the material-crack interface. The two most common forms of ultrasonic testing are discussed below.

Stress waves propagating in the monitor specimen can be detected by PZT transducers which convert mechanical signals into electrical signals (Staszewski et al. 2004). This is an effective means of non destructive testing to determine...

The electromechanical impedance method has emerged as a powerful structural health monitoring tool due to its discrete advantages and its simplicity (Xu 2004). It is mainly used in civil infrastructure, but research shows (Xu 2004) that it can also...

Your literature review will use a variety of organizational structures; in most sections a combination of types will be needed.

Citation types
The two main types of citation are:

Information prominent
A 3.5% NaCl or substitute ocean water solution does not contain the organic and biological constituents of natural seawater (Shifler 2004).

Author prominent
Eid (1990) showed that exposure to synthetic seawater and to natural seawater can produce substantially different results.
Now consider which citation type is used with each of the structures you identified in the sample above. Note that information prominent citations are most frequent in most literature reviews. However, it is often more natural to use author prominent citations when describing chronological developments or pointing out the relationship between studies.

**Writing in your own voice**
A common mistake made by students writing this section is to allow the previous researchers, whose work they are reviewing, to ‘take over’.

**Don’t:**
- indiscriminantly throw in everything you can find on your topic
- merely describe what others have done

**Do:**
- decide first where you want to lead the reader
- organize information to support your own plan
- comment on the strengths and limitations of previous work
- point out how previous studies are relevant to your own project

**Language Focus: Incorporating reader direction and evaluative comment**
Reader direction markers, or signposts, such as ‘however’, ‘furthermore’, and ‘for example’, indicate to the reader how they are to interpret the information you present. Your choice of adjective or adverb can indicate your own attitude to this information.

a. From a literature review investigating heat recovery systems to improve the efficiency of gas turbines.

```plaintext
Whilst the ceramic recuperator has demonstrated reliable performance and structural integrity (McDonald 1995), it is **beyond the budget and time constraints of this project**. Proe Heat Exchangers make a stainless steel annular flow concentric tube heat exchanger which heats two counter-flowing fluid streams to recover exhaust heat from the Brayton Cycle (Proe 2005). The **simple** design is manufactured using **straightforward** machining techniques. **Although** this design may not be able to be integrated into the Monash Gas Turbine, a similar design **principle will be followed in this project**.
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a. **Whilst, although:** The writer uses these ‘signposts’ to direct the reader to an understanding of his position.

b. **...it is beyond the budget and time constraints...:** The writer justifies the rejection of one suitable recuperator design

c. **Simple, straightforward:** The writer justifies his design choice, pointing out its advantages in a positive tone. Compare this with the negative connotation given if the writer had instead written: ‘The **simplistic** design is manufactured using **primitive** machining techniques’.
b. From a literature review investigating pitting corrosion in marine environments.

It is recognised that steels are highly vulnerable to pitting corrosion under marine conditions (Gurappa & Reddy 2003). Most studies to date have been laboratory based using ‘simulated seawater’ of sodium chloride solution, which do not contain the organic and biological constituents of natural seawater (Shifler 2004). Stagnant natural sea-water solutions are also used, but have altered compositions due to decaying biological organisms (Shifler 2004). It has been shown that a substantial variation in results can occur between exposure to synthetic seawater and natural seawater due to the micro-organisms present in seawater (Eid 1990).

a. Most studies...laboratory based. Few studies...natural marine environment: The writer points the reader toward the gap in research which her study aims to fill.

b. ...a substantial variation in results can occur between exposure to synthetic seawater and natural seawater...: The writer clearly states the limitations of existing studies.

Presentation of original work
This is likely to require several sections or chapters. Try to devise section headings which reflect the content and make clear where your original work begins.

Presentation of results
Present your work in the clearest and most accessible format. Diagrams, flow-charts, tables, graphs, pie-charts, maps, drawings (cross-section, elevation), or photographs are some of the most common. All relevant elements of a chart or diagram should be clearly labeled.

Captions: Give each figure or table a number and descriptive title. The title should accurately describe what is shown in the figure, and, except in the case of graphs and tables, should state what it is (diagram, photograph, cross-section).

Location element: Each figure or table must be referred to in your text. The “location element” should refer to the figure or table by number and draw the reader’s attention to what it shows. Then explain in more detail, highlighting the significance of the content.

Sample 1: From a report on the development of a low cost acoustic technique to detect early stage emphysema

The free stream velocities at which measurements were taken, along with the corresponding Reynolds numbers, are given below in Table 1. It can be seen that the low speed flows and the front mid speed flow are laminar, while the other flows are transitional.

<table>
<thead>
<tr>
<th>Location element</th>
<th>Significance</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Table 1 – Free Stream Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Speed</td>
</tr>
<tr>
<td>U₀ (m/s)</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>x = 0.077m</td>
</tr>
<tr>
<td>x = 0.390m</td>
</tr>
</tbody>
</table>
Sample 2: From a report on the development of a low cost acoustic technique to detect early stage emphysema

Discussion
Discuss your outcomes in relation to your project aims and objectives. Acknowledge limitations or errors clearly and suggest improvements or solutions wherever possible. It is important to show, not necessarily that you have succeeded fully in your aims, but that you have analysed your results, taking limitations into consideration, to draw conclusions about their implication, considered reasons for unexpected results, and learned something of value.

Sample: From the same report

The LabView implementation produced results similar to those obtained using the established method. Results from the latex tests confirmed the theory governing wave propagation in porous elastic material, where velocity will vary with frequency and permeability of the porous material. However, an improvement would be to introduce Hilbert Transform function and cross-correlation into the LabVIEW implementation. One important benefit is that experiments could be conducted faster and more efficiently; also, results would be more precise. Errors would be reduced if the average of multiple measurements could be taken at the one frequency.

Language Focus: Reporting words
Your choice of vocabulary indicates your attitude to the information you are giving, in this case your degree of confidence in your results and their implications. You may wish to convey that you are confident that your results would be replicated by others under the same conditions, or that your claims are limited to the context of your own project.
5.1 Temperature

Table 4 and Figure 4 show the effects of temperature on zinc ion leaching in acidic solutions for rubber tyre samples. The results clearly demonstrate that the rate of leaching increases at higher temperatures. One reason for this is that increasing the temperature increases the kinetic energy of the particles in the solution. This causes more zinc ions to detach themselves from the rubber compound and become immersed in the leachant solution.

a. ...clearly demonstrate: the writer is confident of the validity and reliability of the results

b. ...the rate of leaching increases at higher temperatures, ...increasing the temperature increases the kinetic energy..., This causes...: use of the simple present tense indicates that this information is considered to be established and not subject to question

Sample from a report on the design of a small-scale water purification system

Discussion

Two water samples were tested against a control sample. After the first test, the control sample contained 12000cfu/mL, while the filtered sample contained only 52cfu/mL, suggesting that the filters were effective.

The second sample was tested for faecal streptococci, faecal coliforms and E.coli. While streptococci did not appear in any sample, coliform and E.coli tests indicated an increase in both from 10 parts per 10mL of each in the control to 42 parts per 10mL in the filtered sample.

A possible explanation for the increase in pathogens is that the filter had become contaminated after the first series of tests, as it had been immersed in control water for several days in an attempt to increase flux.

c. ...contained, indicated: the writer is reporting what happened at the time of testing, which is past and complete; therefore the simple past tense is used

d. ...suggesting that the filters were effective: the writer makes a soft claim, related only to that particular set of experiments

e. A possible explanation...: the writer does not claim certainty that this explanation is correct

Conclusions and Recommendations

It is important to round off your report with a clear, positive statement of your achievements, acknowledgement of problems and limitations and recommendations for improvements.

- Relate content to the project aims
- Summarise your major findings
- Highlight the contribution of your work
- Acknowledge the limitations of your work
- Make recommendations
  - further work: extension or modification
  - improvement to methodology

The two elements, Conclusions and Recommendations, can be either combined in a single section or presented in separate sections.
This study has compared the results of pulsed flow experiments, both with and without reversal, with the results of steady flow experiments to determine the effect of pulsation on heat transfer in horizontal pipe flow.

Experimental results for pulsed flow without flow reversal showed no significant effect on heat transfer compared to steady flow results. Similarly, a further series of experiments investigating the effect of frequency and amplitude showed only minor influence. Preliminary experiments with reversed pulsed flow, however, indicated significant increases in heat transfer. It is suggested that this is due to the large disturbances in the hydrodynamic boundary layer when the flow changes direction for a short period. Further research is required to determine the maximum achievable enhancement, and identify the parameters which have greatest impact on heat transfer.

It should be noted that the experimental results presented in this report do not agree with the theoretical equations. This may be due to the significant deposits which developed on the inside of the aluminium pipe, or to inconsistent thermocouple temperature. Therefore, careful construction and regular inspection of the test rig is recommended for future research when using a similar set-up.

Additional research into the effect of pulsation on pressure drop in the pipe is also recommended as this was beyond the time and budget constraints of this project.

Despite the above-mentioned limitations, the results of this work clearly indicate that pulsation does have some beneficial effect on heat transfer; therefore further investigation is recommended.

Summary
The Summary is written last of all. It gives an overview of the contents of the whole report, but with a focus on the results. It should:

- briefly state the topic and aim of the project
- outline the main stages of the project
- summarise the major results/outcomes (include significant numerical values if relevant)
- underline the significance of the results or outcome

Abstract, Summary or Executive Summary?
Whichever term is used, all of these perform the same basic function: they provide a reader who does not have time to read the full report, or who is not sure if the content of the report will meet their needs, with an overview of the full report content. The term Abstract is usually used in research articles or conference papers. The title Executive Summary is used in industry, where the summary will usually be read by a manager or other executive who needs an overview of the report content but does not need to master the detail. For general technical reports such as your final year project, the term Summary is sufficient.
Zinc oxide used as a vulcanising agent in automobile tyres can leach out of the rubber into soil and ultimately into waterways from discarded tyres and tyre wear on the roads. There is a large difference in particle size in these two cases. This study investigated the relationship between surface area and leaching rate. Experiments were carried out testing two pH levels and two particle sizes. Inductively coupled plasma techniques were used to measure the amount of zinc ions leached per litre of leachant solution.

Rate of leaching was found to increase with an increase in temperature, a decrease in pH and a decrease in particle size. It was found that temperature had the greatest effect on the rate of leaching, followed by particle size and finally pH. An exponential relationship between leaching rate and temperature was found, which showed that within the temperatures commonly experienced in highly populated areas, the leaching rate did not change considerably; therefore, it could be concluded that particle size, and thus surface area per kilogram, had the greatest effect on leaching rate. Experimentally found rates of leaching for the tyre crumb and tyre chunk samples were extrapolated in order to find likely leaching rates for a whole tyre and for tyre wear particles. It was found that the leaching rate for a whole tyre was approximately $6.2 \times 10^{-11}$ kg/h and much faster for the tyre wear at $9.8 \times 10^{-7}$ kg/h. It was concluded that tyre wear on the roads, rather than whole tyres, was of greatest environmental concern.

“If I remove this summary from the rest of the report and give it to someone else to read, will they know what I did, how I did it, what my overall findings were and what they signify?”

Summary and Conclusions

Students sometimes find it difficult to determine what distinguishes the Summary from the Conclusion. In brief, the Conclusions focus on the outcomes of the project, while the Summary gives a broader overview, summarising key elements of the Introduction, Method, Results and Discussion.
Language Focus: Tenses and Verbs

In the final report the Summary is written largely in the past tense because the project is complete (eg; The aim of the project was to…). However, the significance of the results or outcomes (what they indicate or imply) may be expressed in the present tense. The choice of verb and modal (shows, suggests, indicates, may indicate) expresses degree of certainty.

Summary
In this project, the viability of the stress wave method for structural health monitoring was assessed.

Experiments were conducted (a) on a simple plate structure…. It was established (b) that the presence of mechanical connectors can affect (c) the reliability of … and that stress wave distribution decreases (d) with the increase in damage…

In the next stage, similar experiments were performed (a) on more complex plate structures…. The results suggest (b, c) that, while not as reliable as for simple plate structures, the stress wave method may prove (d) useful when…

Paragraph 1.
…was assessed: The project is complete, so it is referred to in the past tense

Paragraph 2.
a. …were conducted: Experimentation is finished, so it is referred to in the past tense
b. It was established…: The results were established during the analysis of results which is also finished, so the past tense is used
c. …can affect: The writer does not want to claim that the presence of mechanical connectors will always have a certain effect, so uses can to indicate likelihood or possibility
d. …decreases: The writer is confident that the second result can be generalised beyond the experimental context, so uses present tense

Paragraph 3.
a. …were performed: Experimentation is finished, so it is referred to in the past tense
b. …suggest: The results remain in existence, so the present tense is used.
c. …suggest: The writer does not feel the results are clear enough to make a strong claim, but indicates their trend.
d. …may prove: The writer is not sufficiently certain of this to make a hard claim, but wants the readers to be aware of the possibility

Citing and Referencing
You will be expected to cite and reference your source material correctly. See:
- The Library’s online referencing tutorials: http://www.lib.monash.edu.au/tutorials/citing/
- Citing previous research: http://www.monash.edu.au/lis/llonline/writing/general/lit-reviews/3.xml