Report Writing Guide
for Mining Engineers

PAUL HAGAN AND PAM MORT

Mining Education Australia
PREFACE

This edition of the Report Writing Guide for Mining Engineers (MEA Report Writing Guide, RWG or “The Blue Book”) has been revised and expanded to enhance the report writing skills of engineering students; a graduate attribute of the Mining Education Australia (MEA) program. The revisions include: inclusion of the Quick Guide to Referencing, updates to the sections on report structure, format and referencing.

MEA is a collaborative development between the Curtin University of Technology (Curtin), the University of Adelaide (UA), the University of New South Wales (UNSW) and the University of Queensland (UQ) that aims to improve the quality of Mining Engineering education. This initiative is supported by the Minerals Council of Australia.

The RWG is intended to assist students enrolled in the MEA Program through the process of report writing by answering many of the “how should I…?” type questions that invariably arise when preparing an assignment. It should prove useful in preparing reports for laboratory exercises, design projects and the research project or thesis. It should also be a useful resource for the student later in their professional career as a graduate engineer.

The RWG has two major aims, these being to:

• outline the standards and conventions of technical report writing as defined by the Australasian Institute of Mining and Metallurgy (AusIMM), the professional association for Mining Engineers, which has specific requirements for material in its various publications including technical papers in conference proceedings and journals.

• contribute to an improvement in the quality of students’ written assignments.

December 2013

ACKNOWLEDGEMENTS

The authors wish to thank the many students who gave permission for parts of their assignment to be included in this work, The Learning Centre at UNSW for use of its many resources on report writing and, the AusIMM for use of extracts from its publication Guide to Authors.

The authors welcome any comments and suggestions for future editions. Please contact either:

• Paul Hagan, School of Mining Engineering, UNSW at p.hagan@unsw.edu.au, or
• Pam Mort, The Learning Centre, UNSW at p.mort@unsw.edu.au

Many of the references that appear in this publication are fictitious and/or have been altered to better illustrate the various aspects of referencing in reports. The authors apologise if any embarrassment has been caused.
Contents

1 INTRODUCTION 01

2 THE AIMS OF REPORT WRITING 03
   What is a report – what are its aims and objectives? 03
   Who reads a report and why? 03
   What is expected in a report? 04

3 THE REPORT WRITING PROCESS 05
   Clarification 05
   Investigation 05
   Planning 06
   Drafting and editing 06

4 REPORT STRUCTURE 07
   Title page 07
   Statement of originality 08
   Summary 08
   Acknowledgments 09
   Contents 09
   List of figures and tables 09
   List of symbols and definitions 09
   Introduction 10
   Main sections and subsections 10
   Conclusions 11
   Recommendations 11
   References 11
   Appendices 12
Contents (continued)

5 REPORT FORMAT 13
   Layout and formatting 13
   Typefaces and font styles 13
   Section numbering 15
   Page numbering 15
   Page headers and footers 15
   Symbols for units of measurement 15
   Numbers and use of significant figures 17
   Equations and symbols for mathematical variables 18
   Visual information 18
      Tables 19
      Figures and illustrations 19
      Plans and drawings 20
      Captions for figures and tables 21
      Acknowledgement of sources 21

6 REPORT STYLE 23
   Aim to inform 23
   Be concise 23
   Avoid colloquialisms 24
   Do not discriminate 24
   First person or third person? 24
   Be clear 25
   Be correct 25
   Check for jargon 26
   Engagement of the reader 26
   Lists of information 26
   Parallel rule 27
   Spelling of technical terms 27
   Shortened words and phrases – abbreviations and acronyms 28
   Punctuation 28
Contents (continued)

7 REFERENCING IN A REPORT
   When should material be referenced? 31
   Why should I reference material anyway? 31
   Further information on plagiarism 32
   Which sources of information provide good reference material? 32
   How should I reference material in a report? 35
   What information must be provided when referencing?
      Citation in running text or report 35
      Details in the references list 35
   What must be included in a references list? 36
   Primary and secondary reference sources 36
   Some examples of referencing
      Multiple authors 37
      Multiple reference sources 37
      Multiple publications by an author in the same year 37
      Long author names 38
      Discussion or interview 38
      Information obtained from a website 38
      Printed vs. on-line material 39
      Information obtained from data storage media 39
      Lecture, seminar or workshop 39
      Legislation 39
      Missing or unknown date 40
      Missing or unknown author 40
   Managing references 40
   Summary 40

8 REFERENCES 41
Contents (continued)

APPENDIX 1 43
   Examples of referencing various types of information sources

APPENDIX 2 51
   An example of a technical report

APPENDIX 3 63
   An example of a conference paper

APPENDIX 4 71
   Examples of spelling and hyphenation of some mining related terms

APPENDIX 5 73
   Abbreviations used in report writing

APPENDIX 6 77
   A checklist for report writing

QUICK GUIDE TO REFERENCING 81

LIST OF FIGURES
   Figure 1. Variation in the forces acting on a cutting tool with depth of cut 19
   Figure 2. An example of a map or plan 20
   Figure 3. An example of a sketch or line drawing 20

LIST OF TABLES
   Table 1. A sample extract of a Summary section from a student's report 8
   Table 2. An example of a more concise Summary section 9
   Table 3. An example of a Table of Contents 9
   Table 4. An example of an Introduction section in a report 10
   Table 5. An example of a Conclusions section 11
   Table 6. Recommended format settings for a report 13
   Table 7. Recommended report layout settings 14
   Table 8. Conventions with use of numbers, units and symbols in a report 16
   Table 9. Properties of different mineral types (an example of a table layout) 18
   Table 10. A list of discriminatory terms and preferred alternatives 24
   Table 11. An example of a “wordy” piece of writing 25
   Table 12. An example of a “clearer” piece of writing 27
   Table 13. Punctuation conventions 28
The MEA Report Writing Guide was written to help you, the student, to write better reports. This document is not intended to constrain your creative writing talents but to inform you of what is expected when writing a technical report. These expectations are the norms and conventions of report writing explained in terms of structure, format and style. It is argued that the earlier in your professional development you are informed of these expectations the more likely it will have a positive influence and you can use this knowledge to develop good writing habits.

It is an unfortunate misconception held by some students on entering into an engineering program that developing communication skills is of little importance and perhaps even less so written communication. It is incorrectly assumed that engineering is all about maths and physics and using this knowledge to build gizmos. This unfortunately could be no further from the truth.

As well as design and construction, an Engineer will often need to communicate with others whether it be in a business setting, with their peers or while studying at university. There will be occasions when for example a Mining Engineer will need to convince the Board of Directors and/or those in a financial institution to provide funding for a mining project; to convince their manager or a client that a design, plan or mining strategy will meet their particular needs and objectives; or, to justify what needs to be done, how, when, and the estimated costs and rewards.

Technical writing needs to be accurate and precise to avoid confusion and ambiguity. This is no less so in mining when for example as a Mining Engineer you may be required to prepare instructions for mine operators on ground support rules where ambiguity could result in a fatal outcome.

Report writing is the most common form of written communication used by engineers and it should become second nature if you wish to become successful in your career. It is used widely in industry, whether in an operational, management, technical or research role. It is
a form of communication that is well suited to recording observations and analysis, and conveying this information to others.

To this end, proficiency in report writing is a graduate attribute of the MEA Mining Engineering Program. Further evidence of its importance to industry is the requirement by Engineers Australia, the professional organisation for engineers in Australia, to include report writing skills in all engineering programs and the anecdotal feedback from senior management impressing the need to improve the writing skills of engineers.

The sooner a student realises the importance of good report writing and begins to develop the skills of effective report writing, the better the engineer and, in the short-term, the better the marks a student should achieve for assignments whilst at university.

Often a student's first impression of technical report writing is that it is a difficult form of writing as it is highly structured and written in an impersonal style. But as with all skills, a student will become more proficient in it given persistence, time and practice.

Developing this skill early will not only ensure the intended message is understood but prevent bad habits being developed that can be hard to undo. Eventually it will allow the student to concentrate more on the report's content and message that is wished to be conveyed.

While at university you should use this time to hone your report writing skills so that on graduation when you are about to begin your professional career you have made significant progress in mastering this form of communication.

It is recommended students always have available the MEA Report Writing Guide when preparing every assignment requiring a written report. The RWG outlines the report writing standards for all the courses in the MEA program and hence is a key element in the assessment criteria of student assignments.

Initially, it is likely a student will have to often check on the standards and conventions but, over time, this should become second nature. It is also suggested you examine the report writing efforts of others as there are many variations possible which conform with the standards.

Students should be aware that report writing requirements will differ outside of MEA including between different departments in a university and that some fine tuning may be required. This could arise for example during industrial training when you find your employer has slightly different reporting requirements. Even so many of the underlying elements of report writing are essentially similar.

While there are many publications available on engineering and scientific writing with several of these listed in the References section, two recommended publications that a student should acquire are:

- **Guide to Authors** (AusIMM, 2013). This is published by the Australasian Institute of Mining and Metallurgy (AusIMM) which is the professional society for Mining Engineers in Australasia and outlines the requirements for its publications. A copy of the publication can be downloaded from <www.ausimm.com.au>.

- **Style Manual for Authors, Editors and Printers** (Snooks and Co., 2002). This publication is the reference standard used in the government and private sectors.

An on-line resource to develop report writing skills that complements the RWG can be found at the Write Reports in Science and Engineering (WRiSE) website at <learningcentre.usyd.edu.au/wrise>.

When undertaking the research project in the final year of the MEA program, students should be aware of the specific requirements in the preparation of a thesis. These requirements are outlined in Preparation and Submission of Master by Research and Doctoral Theses for Examination (UNSW, 2009a) and equivalent documents at your home university.
What is a report – what are its aims and objectives?

A report is a form of written communication that is used by science, engineering and research organisations and throughout much of industry.

Reports are used to record information, to provide an account of an activity or the results of a study or investigation. Quite often a report will state the objective of the study and include the methodology, an analysis and evaluation, conclusions and recommendations.

As well as being used as a means of recording information, reports can be used to present and discuss options or present an argument intended to influence others in decision-making. How well this is done will be dependent on:

- the quality of the information presented in the report;
- the persuasiveness of the conclusions and recommendations; and
- the quality of the report—how well it is prepared and presented.

Who reads a report and why?

You will be asked to submit many reports as part of your studies at university on matters related to laboratory investigations, field studies, technical design, planning and economic evaluation. Preparation of these reports is an important aspect of the learning process. It is meant to not only aid in understanding of scientific and engineering principles but also to improve your report writing skills.

As a graduate, you are likely to be asked to prepare reports for your supervisor or manager in order to record information, an event, the options on a particular subject, the design of a new project or the outcomes of a completed project or operation.

One critical piece of advice that may help in preparing a report is to direct your writing to the “average” person, a person who may have a general knowledge of the topic but who may not necessarily be a technical expert. For example when preparing a report for assessment at
university, students can make the understandable but sometimes incorrect assumption that the lecturer will be an expert on all aspects of the topic and understands all the concepts and technical language presented in the report. This can lead to short-cuts being taken in communication by the student.

In industry, such assumptions may have undesirable consequences in terms of an unfavourable response, outright rejection of the report and its findings or, implementation of the wrong design leading to a catastrophic event.

It is suggested students practise writing for the average person whilst at university so you will be accomplished in this style of writing by the time you graduate.

What is expected in a report?

The structure of a report allows different forms of information to be amalgamated into the one document. Such information may include:

- design drawings;
- economic analysis, calculations, models, spreadsheets;
- graphs, charts, photographs and other illustrations of equipment, mines, processes and people;
- discussion; and
- critical analysis and synthesis of information.

Although the range of information dealt with in reports and its objectives may vary, there is a common “look and feel” to a report. While the report could be primarily intended for your supervisor, it may also be read by your peers, those in senior management or indeed anyone within the organisation.

Whatever the purpose and whoever the audience, the objective is to gain acceptance of the concepts, ideas and recommendations contained in the report. Effective communication will contribute to acceptance of the report and importantly the message that is intended to be conveyed.

The mechanics of most writing, be it an essay, play or novel, usually have some common elements of structure, format and style. When writing a report these elements are just as evident and have evolved with changes in science, engineering and business.

Adoption of a common structure, format and style in a report will improve the communication process by minimising the clutter or noise that might otherwise confuse or distract the reader. Despite this commonality, there is still sufficient flexibility that reports can be adapted to the needs of different audiences and objectives. Each of these elements of report writing will be discussed in greater detail later in this guide.

In addition to the mechanics of communication, other aspects of a report that will influence the success in acceptance of a report include:

- clarity of thoughts;
- logical development of concepts;
- evidence and/or support for ideas presented in the report; and
- conclusions and/or outcomes of an analysis or study.
As with so many tasks, report writing is an iterative process—especially if a high quality report is desired. The steps in the writing process include clarification of the objective, investigation, planning, drafting, editing and re-editing.

Clarification

In order to write a good report, the writer must have a clear understanding of the report’s objectives. This can be as simple as clarifying questions involving who, what, why, when, where and how related to the report.

• Who is the intended audience of the report?
• What is the topic of the report?
• What is the objective/aim of the report?
• Why have you been asked to prepare the report?
• When does the report need to be submitted?
• Where are the resources to be used in preparing the report?
• How will the report be distributed?

Investigation

Once the objectives are clarified, you can begin the investigation. Depending on the type of report, the investigation can be conducted in a number of ways.

You may need to visit a work site, undertake discussions with a range of people or observe industrial processes and systems. All of this information may need to be documented and analysed. Alternatively, a project may involve experiments to collect data to test a hypothesis. In all such cases, you will need to consider the following questions.

• What questions need to be answered?
• What type of information should be collected?
• Where is the information located?
• How will the information be recorded?
• How will the information be analysed and presented?
Planning

While investigating a topic, you should also be thinking about how the report will be organised. A useful activity is to create a simple outline of the report. An outline is a list of the headings and subheadings that will be used in a report; in essence the order in which information to support the conclusions and recommendations are presented. This will be discussed further in the chapter on Structure.

Creating an outline forces the writer to consider what information should be included in the report and in what sequence. An outline will evolve to form the basis of a report's contents page.

Drafting and editing

Writing a report usually requires a number of drafts to ensure a consistent professional standard and ensure that the report’s objectives have been met. You will need to do the following.

Revise the task often

Do this by keeping the reader's needs and the report's objectives in mind, not only as the information is gathered and analysed but also as the report is being compiled.

Be selective

Do this by keeping clear notes on what information has been gathered, by whom, from where and when. Also critically comment on the veracity and usefulness of this information. Review project notes and draft copies of the report to decide what is essential and discard nonessential information.

Create a structure

Do this by developing the information at several levels: sections, paragraphs and sentences. Consider what sub-headings you might wish to have in each section. Include a summary or overview statement at the beginning of each major section as this improves readability.

Well written paragraphs generally begin with a topic sentence and develop a single idea.

Bullets points are quite often used in reports to good effect for clarity and emphasis; see the section on Lists of information. Tables and figures are often included in reports to aid in communication and to improve understanding and comprehension.

Edit then edit again

The report should be systematically edited. This requires developed organisational skills. Some strategies that you may find useful are as follows.

• Give the draft report “the bottom-draw treatment” by putting aside the draft for at least 24 hours. The report can then be read with a fresh pair of eyes that are more likely to notice any errors or holes in the argument.

• Ask someone else for their comment on the report, preferably someone who is familiar with your field and from whom you can accept criticism.

• Use a checklist to summarise the requirements of a report. Checklists can be found in most good text books on report writing such as that by Winckel and Hart (1996). An example of a simple checklist is provided in Appendix 6. You may wish to compile your own checklist. The objectives and criteria for an assignment should also be included in the checklist.

• Observe what other report writers do well and apply this to your own writing.

• Know your shortcomings! Develop an awareness of what to look for and what to work on to improve your writing skills. Seek assistance from on-campus services such as The UNSW Learning Centre or equivalent at your home university.

The time necessary to properly format and edit a report is frequently underestimated. This is unfortunate as a poorly prepared report will reflect, perhaps unfairly, on the overall quality of the project or study, undoing much of the good work that may have been gone into collecting information and in the analysis.
The structure of a report differs from other forms of writing such as an essay or novel. Whereas an essay is intended to be read from beginning to end, quite often only certain sections of a report may be read by particular people. For instance, senior management are more likely to only read the Summary, Conclusions and Recommendations sections in a report to assess the project outcomes, whereas an Engineer might be interested in the details of the analysis and what assumptions were made during the course of the investigation.

Depending upon its length and purpose, a technical report will generally be divided into several sections; this chapter will outline those which are found in the majority of reports.

Appendix 2 contains an example of a technical report that illustrates how these sections come together in a report as well as addressing elements of report format and style.

**Title page**

The purpose of the title page is to indicate the nature of the subject matter that will be covered in the report through an informative title. Other information found on the title page includes:

- Name of School/Department or Company (e.g. UA, UNSW, UQ, WASM, Blue Mining Ltd)
- Person to whom the report will be submitted (in most instances the course convenor)
- Course name and code
- Title of the report
- Author (student’s name and number)
- Date of submission.

The design of the title page should be simple yet functional and appropriate for the audience and task.

In addition to the formal title page for the report, most universities require their students to attach an *Assignment Coversheet*. You should refer to your Course Outline/Profile for the particular requirements at your university.
**Statement of Originality**

A statement or declaration affirming the originality of the work is required for most student assignments. Generally this declaration is included in the official Assignment Coversheet or incorporated into some report style templates provided to students.

The declaration is also included at the beginning of a thesis immediately following the title page.

The Statement is a formal declaration by the author that it is their own original work and all sources of information including data, illustrations and copyrighted material contained within the work have been properly acknowledged.

**Summary**

The summary contains an overview of the most important aspects of the report. While there are a variety of titles that are used for the name of this section such as abstract, synopsis, executive summary, the recommended title to use in all MEA reports is **Summary**.

*Note: The section headings marked with an asterisk (*) are generally found in a thesis or other scientific publication such as a conference paper. These sections are normally NOT required in a technical report.*

**Table 1**

A sample extract of a Summary section from a student's report with accompanying lecturer's comments.

<table>
<thead>
<tr>
<th>Lecturer's Comments</th>
<th>SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>The structure is good because there are clear stages:</td>
<td>We have been assigned by the directors of Base Metals Australia to</td>
</tr>
<tr>
<td>• terms of reference;</td>
<td>evaluate the primary access alternatives of sinking a shaft or</td>
</tr>
<tr>
<td>• report aim;</td>
<td>developing a decline to access the Southern Cross ore body in the</td>
</tr>
<tr>
<td>• report solution; and</td>
<td>North Parkes region of NSW. In each case a secondary return</td>
</tr>
<tr>
<td>• report scope.</td>
<td>ventilation shaft or decline would be required. Some of the</td>
</tr>
<tr>
<td>Expression could be improved in two areas:</td>
<td>conclusions of this report are undoubtedly applicable for its</td>
</tr>
<tr>
<td>• wordiness; and</td>
<td>evaluation, however, this has not been considered. This report</td>
</tr>
<tr>
<td>• cohesion.</td>
<td>clearly identifies the advantages of utilising decline access for</td>
</tr>
<tr>
<td>Do not write in the first person (I, we etc) in technical writing but rather make</td>
<td>the purpose of employee access and ore recovery at this site.</td>
</tr>
<tr>
<td>use of third person. The underlined words are unnecessary.</td>
<td>In reaching this conclusion the various technical and economic</td>
</tr>
<tr>
<td>In the third sentence, it is unclear what is meant by ‘its evaluation’.</td>
<td>aspects of the two alternatives have been thoroughly considered. In</td>
</tr>
<tr>
<td>The words in bold are implicitly referring to the two access alternatives.</td>
<td>particular the report highlights:</td>
</tr>
<tr>
<td></td>
<td>• the economic advantage to decline access</td>
</tr>
<tr>
<td></td>
<td>• the reduced risk exposure associated with decline access, and</td>
</tr>
<tr>
<td></td>
<td>• the minimal environmental impact of a decline.</td>
</tr>
<tr>
<td></td>
<td>In both cases, excavation by drill and blast was considered the best</td>
</tr>
<tr>
<td></td>
<td>option for mining through the country rock.</td>
</tr>
</tbody>
</table>

The Summary section should be placed between the report's title page and the contents section. Ideally the Summary section should be about one half of a page but **no more than one page and 250 words**.

The summary should succinctly state the objective of the study or report; a description of the process/method that was used in the investigation, major outcomes and results; and, the major conclusions and recommendations.

The term **Executive Summary** is rarely used in MEA reports being restricted to major project reports such as a mine feasibility study or other similar lengthy and comprehensive reports. In this case the summary can extend for several pages.

Similarly, the term **Abstract** is not used in MEA reports but is reserved for a thesis, conference paper or other scientific publication such as a journal article. Examples of a summary section together with critical comments by a Lecturer are provided in Tables 1 and 2.
**Table 2**
An example of a more concise Summary section.

**SUMMARY**

Valley-Power Coal has secured a contract with Valley-View Power Station to supply up to 4.5 Mtpa of coal. The results of this study have found that the best haulage option for Valley-Power Coal is to introduce a truck haulage system. This will require a $10.69 million capital outlay with an average transport unit cost of $2.10 per tonne for the initial 5 year period and $1.97 per tonne thereafter for the remainder of the contract period.

*Lecturer’s Comments*
This summary addresses the main elements in that it briefly provides the context for the study (a new contract), the objective (best haulage option) final recommendation (truck haulage system), upfront costing ($10.69 million capital outlay) and running cost ($2.19 per tonne).

*Acknowledgments*

In this section the author acknowledges the people and organisations that helped and supported the project for example in providing resources and/or information. This would usually include the name of the mine or organisation and relevant key people involved in the project. A few sentences or a short paragraph is usually all that is required. An acknowledgment section is normally included in a thesis, conference paper or research report.

**Contents**

The Contents section, or Table of Contents as it is sometimes referred to, outlines for the reader’s benefit the structure of the report. It is a listing of the section headings and subheadings together with their respective page numbers. Table 3 shows an example of the major section headings in a report.

Another purpose of the Contents section is to assist the reader to quickly locate information in a report. It is optional to use a section numbering system in small reports of less than say six pages though it is nearly always used in larger reports. If a numbering system is used then it should be consistent and reflect the hierarchical nature of the section headings and sub-headings used in the report. A decimal system is quite often used for this purpose; see the Contents section provided in the sample report in Appendix 2.

As indicated in Table 3, the Contents section is not included in the list of contents. However the separate lists of figures, tables and abbreviations can be included. Note also the convention for page numbering—see the section on *Page numbering* in Chapter 5.

*List of figures and tables*

A list of the figures and/or tables contained in a report is often included as an adjunct to the Contents section.

A separate listing is made for each of the figures and tables. Each listing usually follows on after the Contents and should use the same system of formatting. The list should include the figure (or table) number, caption and respective page number.

*List of symbols and definitions*

If a report refers to special or unique names, terminology, symbols or abbreviations at several places in a report, then it may be helpful to the reader to include a list or glossary of terms. This list is usually located at the start of the report following the Contents section. The list should be sorted alphabetically and include the full or alternative form.

**Table 3**
An example of a Table of Contents.

<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary</td>
<td>i</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Objective</td>
<td>2</td>
</tr>
<tr>
<td>3. Test Procedure</td>
<td>3</td>
</tr>
<tr>
<td>4. Results</td>
<td>4</td>
</tr>
<tr>
<td>5. Analysis</td>
<td>7</td>
</tr>
<tr>
<td>6. Conclusions</td>
<td>9</td>
</tr>
<tr>
<td>7. Recommendations</td>
<td>9</td>
</tr>
<tr>
<td>8. References</td>
<td>10</td>
</tr>
<tr>
<td>Appendix 1: Risk assessment</td>
<td>11</td>
</tr>
<tr>
<td>Appendix 2: Project schedule</td>
<td>13</td>
</tr>
<tr>
<td>Appendix 3: Equipment specifications</td>
<td>15</td>
</tr>
<tr>
<td>Appendix 4: Listing of test data</td>
<td>18</td>
</tr>
</tbody>
</table>
Introduction

This is the first section in the main body of a report.

The Introduction is important as it sets out the context for the report. It should clearly define the objectives of the study, any constraints or boundaries (scope) to the study and relevant background information.

At this stage of the report, there should be no discussion on the findings or recommendations.

The introduction can be as short as a single paragraph or as long as several pages in larger reports. An example of an introduction is shown in Table 4.

Main sections and subsections

The structure of the main body of a report will vary depending on its purpose. For example, a report in industry might detail an investigation such as a review of ore reserves. Alternatively, a report might have to be prepared on the findings of a study on say alternate dust suppression systems for haul roads. In other cases it might be required to report on observations and information gathered during a field trip to several mine sites detailing leading practices.

Each of these reports requires a different structure. The following examples show some of the different types of structures that can be used in a report.

**General report**

*Purpose:* To provide a balanced account on a topic or on an area of knowledge. The report is a record of the investigation and its outcomes.

A record of a project or study is necessary for several reasons, least of which is to ensure the work or actions are not unnecessarily repeated in the future. The study will involve gathering information from different sources, analysing this information and making a conclusion. The report is meant to be a record of the investigation and details the findings of the study.

The main body of this type of report might entail:

- history of the issue;
- current understanding of the issue;
- investigation process or methodology used;
- models developed to aid analysis;
- verification of these models and an analysis;
- future directions and/or solutions based on the findings of the report; and
- other impacts or aspects to consider.

<table>
<thead>
<tr>
<th>Lecturer's Comments</th>
<th>INTRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>In terms of content, this sets out the terms of reference, provides a brief background and the aim of the study.</td>
<td>CCMH Engineering Pty Ltd was approached by the Aluminium Company of Australia (ACA) to conduct an analysis of the bulk haulage options between ACA No.1 Bauxite Mine and the Coolenup Refinery.</td>
</tr>
<tr>
<td>In terms of style, the second paragraph sets out the project constraints. Statements which refer to conditions (e.g. “is 15 km”, “is set at 8 yrs”) are usually written in the present tense. Whereas statements about actions (e.g. “was given as”) are best written in the past tense.</td>
<td>The direct distance between the sites was found to be [is] 15 km and approximately 30 km by haul road. The required capacity for the materials handling system was given as 8 Mtpa. The design life of the system is [is set at] 8 years with a possible extension to 12 years. CCMH Engineering was commissioned to investigate the economic, environmental and social cost of each of two haulage options, these being truck and conveyor haulage.</td>
</tr>
</tbody>
</table>
| Main criteria to be used are clearly presented. Brief description of methodology and report structure is included. | The final decision on which bulk haulage option was to be recommended was based on: [The final recommendations should be based on:]
| Words written within square brackets are suggested alternatives | • economic viability, • environmental considerations, • safety considerations, and • social considerations |
| This report aims to clearly set out the detailed analysis of both haulage options. In each case, a complete transport system has been designed, costed and analysed. |
**Experimental report**

*Purpose:* To describe a program of experimental work in sufficient detail which will permit the method, results and conclusions to be reviewed and, if necessary, modified and/or repeated.

It is usually important in such instances to draw conclusions from the data and to place these conclusions in the context of other related work, that is in the published literature. Typical section headings might include:
- Theory (and/or current knowledge on the subject setting the context for the project);
- Objectives;
- Procedure/Method;
- Results; and
- Analysis and Discussion.

A report on a complex research program (for example a thesis) may involve several chapters, each containing a section on the particular procedure or method used followed by the results and a discussion on the findings.

**Practical work report**

*Purpose:* An account of activities, events and/or observations.

Typical sections might include:
- Site description—what the organisation does/produces, layout, staff organisation
- Description of work/activities/systems/plant
- Description of other work/activities observed
- General comments on building, layout, technical facilities and amenities
- Outline of industrial relations.
- For a detailed guide on writing a field visit report, see the WRiSE site at <learningcentre.usyd.edu.au/wrise/home-B.html>.

**Conclusions**

Every report must include some concluding statements linking the original objectives with outcomes of the study. This section addresses the "so what" questions – what was found and what impact will this might have on the subject. It might comment on the impact of the study, what was found in an analysis of test results, field trip, or on say the organisation and what was been learnt as a result of the study. It is in both this section and in the analysis that you demonstrate your insight in the topic and an ability to synthesise new information. A sample conclusion is provided in Table 5.

**Recommendations**

The Recommendations section outlines what further work might be necessary to address any unresolved issues and/or alternate approaches in light of what was found in the study.

**References**

This section of the report contains an alphabetical list of all references that were cited in the report; only reference sources cited in the report can be included in the list.

There are specific requirements as to:
- what publication details need to be included for each reference;
- the order in which this information is arranged; and
- the punctuation that must be used.

See Chapter 7 *Referencing in a report* for further details.

**Table 5**

An example of a Conclusions section.

**CONCLUSIONS**

This report has established on the basis of cost, geotechnical issues, environmental impact, exposure to risk and being fit for purpose, that a decline development is the better option for the primary access to the proposed mine at a production rate of 1 Mtpa of ore. Further development of the mine beyond the 400 Level may require alternate access but this would be subject to a thorough evaluation before making a decision.

*Lecturer’s Comments*

The conclusions are short and to the point. They restate the major findings and also recommend further work or decisions that may be needed if circumstances change.
An example of a reference list is shown in the sample technical report provided in Appendix 2. The list includes examples of different types of information sources in the required format.

The reference list must be sorted alphabetically first by author and then chronologically by year of publication.

Appendices

The Appendix section serves to provide additional or supporting information that, while not crucial to an understanding of the main facts and interpretation of results, the information may be required by the reader for verification of data.

The main body of the report should contain information that is directly relevant to the discussion. Information that indirectly supports the discussion should be inserted in the appendix.

As with figures and tables, there should be a link between the main body of the report and each appendix. The reader should be directed in the main body of the report to the appropriate appendix, for example “...additional data are presented in Appendix A.” See the section Section numbering in Chapter 5 for details on numbering convention in an appendix.

Some examples of the different types of information that can be found in an appendix include:

- listing of raw/primary data;
- detailed description of equipment and/or drawings;
- model and/or configuration/settings;
- material safety data sheets (MSDS);
- product data sheet and equipment specifications; and
- copies of questionnaires used in a survey.
Layout and formatting

While the layout and format of a report is a matter of personal preference there are some norms that need to be observed. The format should make the report easy to read and be pleasing to the eye—it should not be a cause for annoyance or distraction to the reader.

Just as important, formatting should be consistent in a report. Table 6 shows suggested format settings in a report.

Typefaces and font styles

Traditionally the text in a report use the serif family of typefaces such as Times New Roman as it is easier to read. Section headings on the other hand generally having a larger font often use sans serif typefaces such as Arial or Helvetica.

Italics and bold fonts are subsets of a typeface and are used whenever special emphasis is desired for particular words in the text.

<table>
<thead>
<tr>
<th>TABLE 6</th>
<th>Recommended layout settings for a report.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layout option</strong></td>
<td><strong>Setting</strong></td>
</tr>
<tr>
<td>Left margin</td>
<td>30 mm (this leaves sufficient room for binding and comments)</td>
</tr>
<tr>
<td>Right margin</td>
<td>20 mm</td>
</tr>
<tr>
<td>Top margin</td>
<td>25.4 mm (alternatively 20 mm)</td>
</tr>
<tr>
<td>Bottom margin</td>
<td>25.4 mm (alternatively 20 mm)</td>
</tr>
<tr>
<td>Line spacing</td>
<td>1.5 lines</td>
</tr>
<tr>
<td>Spacing between sentences</td>
<td>Single space following a full stop</td>
</tr>
<tr>
<td>Spacing between paragraph</td>
<td>12 point</td>
</tr>
</tbody>
</table>
A common trap for novices is to make too much use of the various font options and it should be avoided.

The *italics* font is used to give emphasis to a phrase or an entire sentence. It can be used to denote a quotation and the title of a publication.

A **bold** font, being more striking to the eye, is used to give added emphasis but should be restricted to only a few words at a time. Where emphasis is required for three or more words then it is suggested to use italics. Bold is often used for major section headings in a report.

A third option that can be used to give emphasis in the text of a report is the use of CAPITALS. Aside from section headings, this option is particularly useful in circumstances where a reader might otherwise misread the meaning of a sentence such as “water from outlets in this laboratory is not potable and MUST NOT be consumed.” As capitalised words are more difficult to read, they should be used sparingly.

With the development of desktop printing, underlining is rarely used having been replaced by bold and italic fonts. It is reserved for those occasions when you might want to alert the reader to where use of other font styles may not be appropriate. Underlining for example can be particularly effective whenever part of a word needs to be emphasised, for example unrepresentative. As with the use of capitals, underlining should be rarely used in reports.

A list of layout settings recommended for use in a report is shown in Table 7.

Many word processing software packages now include provision for style sheets. Once configured, these simplify the task of formatting the different elements of a report such as

---

**Table 7**

<table>
<thead>
<tr>
<th>Format option</th>
<th>Setting</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heading:</strong> Level 1</td>
<td>Start each section on new page; Line spacing: 9 pt after; Hanging 1.4 cm; Typeface: Arial, Calibri (Light) or Helvetica; Font: 18 pt, All caps, bold</td>
<td>1</td>
</tr>
<tr>
<td><strong>Heading:</strong> Level 2</td>
<td>Line spacing: 12 pt before and after; Hanging 1.4 cm; Typeface: Arial, Calibri (Light) or Helvetica; Font: 14 pt, Small caps, bold</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Heading:</strong> Level 3</td>
<td>Line spacing: 6 pt before and after; Hanging 1.4 cm; Typeface: same as body text; Font: 12 pt, bold italic</td>
<td>1.2.3</td>
</tr>
<tr>
<td><strong>Heading:</strong> Level 4 (rarely required)</td>
<td>Line spacing: 6 pt before; Typeface: same as body text; Font: 12 pt, regular</td>
<td>1.2.3.4</td>
</tr>
<tr>
<td><strong>Body text in report</strong></td>
<td>Paragraph spacing: 12 pt before; Line spacing: 1.5; Typeface: Times New Roman, Cambria or Palatino (Linotype); Font: 12 pt; Margins: left and right justified</td>
<td>...section headings in a report.</td>
</tr>
<tr>
<td>Tables/figures</td>
<td>Spacing: 12 pt above and below the table/figure from text; Centred within margins</td>
<td>A third option that can be used to give emphasis in the text of a report is the use of .....</td>
</tr>
<tr>
<td>Captions for table and figures</td>
<td>Centred above a table and centred under a figure; Typeface: same as body text; Font: 10 pt</td>
<td></td>
</tr>
<tr>
<td><strong>Table contents</strong></td>
<td>Typeface: Arial, Calibri or Helvetica; Font: 9 or 10 pt; Text: right justified in left hand column, left justified/centred other columns; Values: centred or tab aligned to decimal point</td>
<td></td>
</tr>
<tr>
<td><strong>Page numbers</strong></td>
<td>Typeface: same as report; Font: 10 pt; Position: top right hand corner of page</td>
<td></td>
</tr>
<tr>
<td><strong>Header</strong></td>
<td>Typeface: same as report; Font: 10 pt</td>
<td></td>
</tr>
<tr>
<td><strong>Footer</strong></td>
<td>Typeface: same as report; Font: 10 pt</td>
<td></td>
</tr>
<tr>
<td><strong>Reference list</strong></td>
<td>Align left; Indent second and consecutive lines; Typeface: same as report; Font: same as text, left justified</td>
<td></td>
</tr>
</tbody>
</table>
headings, paragraphs, figure captions etc. Style sheets also help to ensure consistency in formatting throughout a report.

On a final note, combining different font styles (that is italics, bold, underlining) should be avoided.

Section numbering

Numbering of section headings and subheadings is often used in reports. A hierarchy of headings and sub-headings can be used to good effect especially in larger reports. Up to three levels or divisions of headings are usually sufficient for most reports (for example “8.4.3 Errors in data acquisition”) though up to four levels may be used in very large documents such as a thesis. Too many levels may become confusing for the reader and can be cumbersome for the writer to manage.

The words section, chapter, appendix etc should be treated as proper nouns and hence the first letter should always be capitalised, for example “further information can be found in Section 8.2.”

Similar to the main body of a report, an appendix can be divided into sections each containing disparate information. A different numbering convention should be used to distinguish it from the main body of the report. Two examples of a numbering systems that can be used in reports are:

- Appendix A, Appendix B, Appendix C etc; and
- Appendix 1, Appendix 2, Appendix 3 etc.

As with section numbering, the numbering system of tables and figures in an appendix should be different to that used in the main body of a report. Often the table or figure number is preaced by the number or letter of the appendix, for example “…see Figure A-1” alternatively it can be referred to as a table or figure in a particular appendix, for example “…as shown in Table 3 of Appendix 2 …”

Page numbering

The report’s coversheet and title page should NOT be paginated. Page numbers for the preliminary sections up to and including the contents section are set in lowercase Roman numerals (i.e. i, ii, iii etc).

Page numbering set in Arabic numerals (i.e. 1, 2, 3 etc) recommences at the start of the main body of the report with the introduction section immediately following the contents section.

While in most published works and theses, page numbering in the appendix often follows on from the main body of the report, numbering of pages in an appendix is optional in short reports. Even so, the various major sections contained in an appendix should be listed in the contents section.

While there are several positions on a page where a page number can be located, the preferred position is in the top right hand corner within the page header portion of the page.

Page headers and footers

Page headers and footers are often over-used. The best advice is to include the minimal amount of information such as a page number only.

In textbooks, the header often contains the name of the book or the chapter heading. In a report, the header can contain the abbreviated report title. In industry, the footer sometimes contains the file name for document control or the name of the organisation.

An elaborate design for a header or footer adds little value. The main issue is too much information may distract the reader. If you wish to make use of headers and footers then you should ask how will the information aid in communication and is it really essential? If used, its impact can be reduced by using a smaller font size.

In a thesis, the convention is to place only the page number in the header and nothing in the footer.

Symbols for units of measurement

In general, all measurements should be stated in metric units based on the International System of Units (SI) and according to industry convention. There are though a few exceptions, for example imperial units are still used in some parts of industry when referring to engine power rating
(hp), wheel rim size (in), air pressure (psi) and gold production (oz).

When stating a quantity it should be written as the value followed by a space and then the appropriate unit (e.g. ten metres). When using numerals, the abbreviated symbol for the unit should be used rather than the name of a unit e.g. 10 m, 25 kg. Two exceptions to this rule are the unit symbols for currency and temperature when no space is required, e.g. $780, 10°C.

It is recommended to **insert a non-breaking space** by typing Ctrl-Shift-Space between the value and its unit to ensure they appear together on the same line.

Unit symbols must be set in lower-case roman font not italics so as to confuse it with a mathematical variable. The exception is those units named after a person, for example N after Sir Isaac Newton and Pa after Blaise Pascal. The name of the unit, however, is always written in lowercase font (e.g. one newton) except the unit for temperature (e.g. ten degrees Celsius). The unit symbol for litre can be written as uppercase “L” to distinguish it from the numeral “1”.

The plural form is applied when the name of a unit is used (e.g. 10 newtons) but not to unit symbols. Unit symbols are a special form of abbreviation that do not take full stops unless when ending a sentence.

When combining units, insert either a centre dot (·) or non-breaking space (e.g. N·m or N m). For division insert a solidus (“/” which is Unicode 2044 with spaces inserted on both sides (e.g. t/h) rather than the forward slash “/” or Unicode 002F) or use the negative exponent (e.g. N/m², N·m⁻² or N m⁻²).

Some of the more commonly used units of measurement are as follows.

- **mine products such as ore, coal and other materials** are usually reported as tonnage in units of mass that is either in tonnes, kilotonnes or million tonnes (e.g. 2.45 t, 7.6 kt, 12.4 Mt). One exception is the use of troy ounces for gold reserves, production rate and cost (e.g. 3.6 million ounces, $290/oz).

- **overburden and other materials excavated as part of a mining system** are often reported in units of volume that is in cubic metres (e.g. 1450 m³). More often especially in surface mining it is usual to refer to the *in situ* material volume in units of bank cubic metres (bcm) (e.g. 2.8 x 10⁶ bcm).

- **material production rates and material output** are usually reported in units of mass for mine product (i.e. coal and ore) and units of volume for other material on a unit time basis (e.g. 67 t/h, 7200 bcm/shift, 34.5 Mt/yr).

---

**Table 8**

Conventions with the use of numbers, units and symbols.

<table>
<thead>
<tr>
<th>Rule</th>
<th>Example</th>
</tr>
</thead>
</table>
| Use numerals when combined with units of measurement and when associated with abbreviations | 4 km, 2 t, 6%  
| | The 2nd and 20th samples |
| Use numerals for values greater than nine otherwise use words except in the case of a comparison involving a series of numbers | There were three ball mills in use.  
| | The flotation circuit consisted of 6 lead cells and 12 zinc cells. |
| Spell out all figures if they are placed at the start of a sentence | Twenty-five risk values are given |
| No comma or space is inserted for values less than 10000 | 1100, 5430 t, 9990 m |
| For values which exceed 10000, a thin non-breaking space (e.g. 4 pt) should be inserted (Ctrl-Shift-Space) | 11 500 kg (as opposed to 11 500 kg)  
| | 1228 000 tonnes (or 1.23 Mt) |
| Express fractions as decimals | 2.5 s, 2.75 g |
| Include a non-breaking space (Ctrl-Shift-Space) between a value and its unit except for currency and temperature | 22.5 Mtpa, 36.4 x10⁶ bcm,  
| | $45m, 33.1°C |
• bulk density of a rock is usually reported in units of tonnes per cubic metre (e.g. 2.45 t/m³, 3.2 t/bcm).

• blast hole diameter and length of blast hole are usually reported in millimetres and metres respectively (e.g. 215 mm, 12.5 m).

• rock strength is reported in units of stress, usually megapascals (e.g. 18.6 MPa) and applied force or load in newtons (e.g. 132 kN).

• currency by default is usually reported in Australian dollars (e.g. $5.6 million, $4.3m,) though in terms of markets and exports other currencies can be used such as U.S. dollars or Japanese Yen. Where two or more currencies are used within the same report then either a prefix should be used to distinguish between the different currencies or the three letter IS 4217: 1995 code (e.g. A$145m or AUD145m; US$6.2m or USD6.2m; ¥3.15b or JPY3.15b; €2 400 or EUR2400). Note in this context, the lowercase “m” is an abbreviation of million not the prefix mega and no space is required following the value.

• quality/percentage, use the symbol % when combined with a numeral (e.g. 6.4%) but use “per cent” whenever the value is written, for example “ten per cent of ….”

• digital capacity or size is expressed as a bit (b) for a binary digit and byte (B) for a multiple of bits, e.g. kilobit (kb), megabyte (MB), terabyte or 10¹² (TB).

While the use of forward slash is often used to denote unit rate it should only be used with unit symbols (e.g. 67 t/h), otherwise the term “per” should be used with units (e.g. kilolitres per second). One exception sometimes used in industry is the use of the term “pa” (per annum) when reporting annualised production rates (e.g. 34.5 Mtpa).

A list of commonly used units in mining can be found in Appendix 5.

For further detailed on numbers and units of measurement see Chapter 11 in the Style Guide Section 12.3 in the Field Geologists Manual (AusIMM, 2001) and International Standard IS 80000-1: 2009.

Numbers and use of significant figures

When stating a value in a report use either an appropriate scientific notation (e.g. 6.8 x 10⁹) or an appropriate scaling prefix with the unit of measurement, for example M for mega- (x 10⁶), k for kilo- (x 10³) and m for milli- (x 10⁻³). Note the inclusion of a non-breaking space immediately before and after the multiplication symbol, “x”.

For scaling factors up to and including one thousandfold (i.e. kilo), the prefix symbol is written in lowercase (e.g. mm, kg) but above this level the prefix is capitalised (e.g. Mt, GPa) however lowercase is always used when the unit written in full (e.g. millimeters, gigalitres).

Particular attention should be paid to the number of significant figures for a value as this implicitly assigns a level of accuracy to that value. In most instances three significant figures will normally suffice when stating a value (e.g. 13.5 Mt). When estimating mineral resources and ore reserves, clause 33 of the JORC Code states “Ore Reserve estimates are not precise calculations. Reporting...should reflect the relative uncertainty of the estimate by rounding off to appropriately significant figures." Further clause 25 states “...to emphasise the imprecise nature of a Mineral Resource, the final result should always be referred to as an estimate not a calculation.” With respect to the reporting of ore reserves the code is more conservative stating “in most situations, rounding to the second significant figure should be sufficient” (JORC, 2012).

An often made mistake by students when using a spreadsheet is to “cut and paste” the calculated value directly into the report, failing to take account of the number of significant figures.

For example in estimating ore reserves tonnage, a student’s spreadsheet model might estimate the mass to be 1 346 578.574 t. This number has ten significant figures inferring an accuracy of ±0.5 kg corresponding to less than 1 m³ which is unrealistic considering drill hole spacing can often be tens if not hundreds of metres. While this number can be included with the calculations provided in an appendix, the more appropriate
value that should be stated in the main body of the report is $1.35 \times 10^6$ t or 1.35 Mt.

Be wary of inappropriate use of upper and lowercase typeface in units as they denote different scaling factors and hence different values. For example 10 MPa (i.e. $10 \times 10^6$ Pa) is not the same as 10 mPa (i.e. $10 \times 10^{-3}$ Pa).

Some word processor packages may automatically change the capitalisation when typing presuming a mistake has been made. This situation frequently occurs when referring to the unit of stress or pressure where for example it might have been intended to write 250 MPa but unknowingly it has been “corrected” to 250 Mpa. While this can be unfortunate and annoying it is in the end the responsibility of the writer to ensure that both the value and its unit are correctly stated in a report.

There are a number of conventions with respect to the use of numerals in reports. These conventions are summarised in Table 8.

**Equations and symbols for mathematical variables**

Symbols for quantities generally use letters from the Latin or Greek alphabet and are set in italic type.

Equations are generally indented or centred on a page, for example:

$$\begin{align*}
y &= mx + b \\
x &= \lambda(h + f)
\end{align*}$$

Centre tabs can be set to align the centre of the equations.

Equations should be consecutively numbered as they appear in the report, with each number placed in brackets and set using a tab to the right hand margin.

Each equation should be referred to in the text of the report by its assigned number, for example “...as shown in Equation 1.”

**Visual information**

Aside from text, other modes of communication are often used in reports such as illustrations (or figures) including graphs and photographs and, tables of information. A graph can be used to good effect to illustrate the nature of a trend or relationship between two variables.

*Figures* include a range of illustrations such as graphs, technical drawings, sketches, photographs, maps and plans. Figures are intended to aid in understanding of a concept discussed in the report. Graphs are a means of displaying measured quantities and can be particularly useful in communication by creating a visual *representation of data*. Tuft (1983) stated that “excellence in statistical graphics consists of complex ideas communicated with clarity, precision, and efficiency.” He further stated that graphical excellence provides the viewer with “…the greatest number of ideas in the shortest time with the least ink in the smallest space.”

*Tables* are a means of presenting data arranged in columns and rows. The data might be quantitative, qualitative or some combination of both. They are used when the exact values of the data are important to the discussion.

Figures and tables should be included in a report only to assist in the communication process. They *are used to supplement discussion in a report or reinforce a particular point*. As such they should form an integral part of the discussion and not be used as a replacement for text.

Hence each and every figure and table contained in a report must be referred to in the running text by reference to the caption number of the figure or table.

If there is no link then the figure/table must not be included in the report. The text should explicitly highlight to the reader the particular points illustrated in the figure or table; that is what the reader should look for in the table or figure.

**Table 9**

Properties of different mineral types.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Formula</th>
<th>Hardness (Mohr scale)</th>
<th>Density (t/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentite</td>
<td>Ag₂S</td>
<td>2 - 2.5</td>
<td>7.3</td>
</tr>
<tr>
<td>Galena</td>
<td>PbS</td>
<td>2.5</td>
<td>7.4 - 7.6</td>
</tr>
<tr>
<td>Sphalerite</td>
<td>ZnS</td>
<td>3.5 - 4</td>
<td>3.9 - 4.1</td>
</tr>
</tbody>
</table>

Source: AusIMM (2001)
When designing visual information, ensure sufficient labels and headings are provided in the figure or table.

Any symbol or abbreviation used in a figure or table must be explained in the report. Units of measurement in tables are usually contained within brackets in the column or row headings. Explanatory notes can be added directly under the table, usually in a smaller size font.

**Tables**

Table 9 illustrates the following points concerning the layout of a table.

- Data in the table are arranged with column and row headings.
- Units where appropriate are provided within brackets in the column heading.
- The table is centred on the page.
- Lines are used to differentiate headings from data in the table. The use of shading and colour should be avoided.
- The caption description is succinct and conveys the meaning of the association between the different data. Captions are usually a descriptive statement to focus the reader's attention on a particular issue evident in the table.
- A table should not be copied and pasted as a scanned image into a report. It is preferred that the information should be re-typed into the report.

**Figures and illustrations**

Each illustration should be selected so that the message intended to be conveyed is clear and unambiguous.

The quality of the illustration is also important. If the image is of poor quality then it should not be included as it will not only detract from the overall quality of the report but the information intended to be conveyed might be confused. Instead re-draw or re-graph the illustration.

The size of the figure in the report should be such that all the essential information is clearly legible to the reader.

Colour can often be effectively used to differentiate or highlight particular points in an illustration. But this only applies if the report will be printed in colour! It should be used judiciously as overuse can sometimes distract the reader.

The use of grey scale and different line types (thickness, solid/broken lines etc) can often be applied to the same effect as colour.

The illustration shown in Figure 1 illustrates the following points when preparing a graph for inclusion in a report.

- The graph is centred on the page/column.
- The independent variable is shown on the x-axis of the graph and the dependent variable shown on the y-axis.
- Both axes are clearly labelled with units of measurement indicated.
- A bold sans serif font has been used to give added emphasis to each of the axis labels. The size of font is not too large as to be out of proportion with the graph.
- Values are shown on both axes to indicate scale. The upper and lower limits of the range for each axis were selected to more clearly show the nature of the relationship. Again a sans serif font was used for the values but without bold and is smaller than the axis label.
• A sufficient number of tick marks have been placed along each axis to indicate the scale without unduly cluttering the axis.

• A line of best fit has been added to show the nature of the underlying relationship rather than a line drawn from point-to-point.

• A label has been placed against each line to identify and distinguish each variable.

• As multiple measurements were made at each level of the independent variable the average value of the dependent variable is shown together with the corresponding range indicating the standard deviation.

**Plans and drawings**

In the case of plans, maps, charts and technical drawings of equipment there is an additional set of requirements. These types of illustrations should include a scale, legend for the different symbols used in the illustration and where appropriate a north direction indicator.

It is optional whether to enclose illustrations within a border that designates the limits of the illustration on the page.

The geological plan shown in Figure 2 includes information necessary to identify the location of the mine, an insert locality map, a scale, arrow indicating direction of true north, longitude and latitude and a legend for the structural features used in the plan.

Figure 3 shows an isometric perspective of a stope and various other underground excavations in an underground mine. Labels are used to identify the different elements surrounding the stope.

Generally, technical drawings of equipment or their components should also include the angle of projection, the date drawn/last modified and who drafted the drawing.

Large illustrations can be printed in landscape format on the page. In this case they should be placed so that the top of the illustration is aligned closest to the binding. Even larger illustrations such as spreadsheets and mine plans can be printed on large format paper for
example A3 size then folded and placed in the Appendix section.

Captions for figures and tables

Figures and tables should, as far as possible, be self-contained in terms of highlighting a particular point for the reader’s attention. A caption plays an important part in achieving this and so a caption must be included with every figure and table in a report.

The caption for a figure or table has two parts: a number and a concise description. It is customary to consecutively number all figures and tables in the order that they are placed in the report (e.g. Table 1, Table 2 and, Figure 1, Figure 2). The description should be sufficiently detailed to explain the information in the figure or table.

As a general rule, captions for figures and tables are centred on the page whereby:

- captions for tables are placed above the table as for example shown in Table 8; and
- captions for figures are placed below the figure as for example shown in Figure 1.

Every figure, table and equation in a report must be referred to by its caption number in the text of the report.

When referring to a figure, table or equation, it is sufficient to refer to the respective figure/table number only. Do NOT use expressions such as “…refer to the figure above…” or “…as the following figure shows…” This is not only redundant but opens the report to errors as later editing may alter the location of the figure relative to the text.

It is always desirable to place the figure or table in close proximity to and preferably after the paragraph where it is has been referred to in the text of the report.

The words figure, table and equation should be capitalised and treated as proper nouns when used as part of a caption number, for example “…as shown in Figure 1.” While in some journal papers the abbreviated form of the label is sometimes used, in reports they should not be abbreviated.

As with values and units, it is good practice to insert a non-breaking space between the word figure (or table) and the caption number by typing Ctrl-Shift-Space to ensure they appear together on the same line.

When copying a table or a figure from another publication do NOT paste the original caption into the report. The original caption is unlikely to be compatible with both the numbering system and formatting used in your report. Instead create a new caption for the table/figure in keeping with the rest of your report.

Acknowledgment of sources

As well as information, the source of any illustration or table placed in a report must be acknowledged no matter whether it is a direct or modified copy of a illustration, table or other material.

The following conventions are used when citing a reference.

- Table: the citation is placed directly under the table using an expression such as “Source: Smith (1994).” The citation is often written in a slightly smaller font say 8 or 9 point as shown in Table 9.

- Figure: in the case where the illustration is a copy without any changes then the reference follows the figure caption within brackets in the form “(Gloyne, 1993)” as shown in Figure 2. If changes have been made or the illustration is redrawn then add the word “after” before the citation for the original illustration, for example “(after Hall, 1993)” as shown in Figures 3.

When citing the reference source it is preferable to cite the original or primary source of the illustration especially if it has not been altered rather than a secondary source such as material appearing in a course learning guide.
Scientific or technical writing differs from literary writing in a number of ways. Primarily, the aim of technical writing is to inform the reader rather than to entertain. Hence the writing style should be simple, concise and objective.

As reports usually are intended to inform the reader about what has been done, analysed and/or concluded, they are generally written in the past tense.

There are times though when it is more appropriate to use the present or future tense, for example what are the constraints to a project (present tense) or what is planned/recommended to be done in a future project (future tense).

Objectivity - aim to impartially inform the reader

Since the primary aim of the report writer is to inform, emotive language should be avoided. The student is advised to convey information as objectively as possible.

An example of a literary sentence might read as:
“The wind was blowing fiercely and the air outside was getting cooler.”

Whereas a scientific or technical style would probably read as:
“The wind velocity was 45 kph which reduced the air temperature to 15°C.”

Be concise

Being concise refers to both word selection and sentence structure.

Word selection

Use words and expressions economically. If you can use one word instead of two or three, then choose the one word. Often the single word is more precise and more suited to a written context, while the two-word phrase is usually an idiom and open to multiple interpretations. For example, use “avoid” in preference to “get around” and “investigate” in preference to “look into.”
Further, while the style of report writing tends to be formal, this does not mean being bombastic and using overly extravagant language. This is often a trap for new writers.

The intent of the report is, for example, convey to the reader the writer's knowledge of a subject area and/or to demonstrate their ability to analyse and synthesise information; that is the emphasis should be on the content with the report being a means to convey this understanding.

Report Writing is not intended to be an exercise in lexiphanic writing (from the Greek lexis meaning using, or interlaced with, pretentious words, bombastic). Hence avoid the delivery mode over-powering the message else the message may become less transparent or worse still, the reader may become alienated and less likely to accept of the message.

Sentence structure

Avoid long sentences. Sentences with four or more clauses (or parts) can be confusing to the reader. Your text will often read better if you consider making two shorter sentences rather than one long sentence. If you need to include some qualification or an example then a long sentence might be acceptable.

An example of a long sentence is:

"After consulting three manufacturers: Dibble and Co., Sooky Ltd, and Bungle Pty Ltd, we have found two types of vibration suppression devices for the driver’s seat in a haul truck and both are simple in design but have inherent shortcomings."

A more concise sentences might be:

"Three manufacturers were consulted: Dibble and Co., Sooky Ltd, and Bungle Pty Ltd. Two vibration suppression devices were identified for the driver’s seat in a haul truck. Though each design is simple both have inherent shortcomings."

Similarly, avoid long paragraphs and especially one long sentence paragraphs. A simple but effective rule is that each paragraph should address one theme. The theme should be introduced in the opening sentence, developed in the body of the paragraph with a concluding remark made in the final sentence.

Avoid colloquialisms

In most instances report writing requires a formal style of writing. This differs from the choice of words and patterns of speech used in everyday conversation and its use should be avoided in a report. This includes expressions otherwise known as colloquialisms such as “...it can clearly be seen that...” and “…it is generally understood that...”

Do not discriminate

Nondiscriminatory language must be used when talking generally about people. Nondiscriminatory language helps avoid stereotyping, patronising and demeaning people on the basis of their gender, status or race. This issue will be even more important in the workplace when you graduate. Some examples of discriminatory language and acceptable neutral terms are provided in Table 10.

First person or third person?

The strong preference is to use the third person whenever writing a technical report. This means that whenever possible, avoid speaking directly to the (e.g. your) audience and avoid use of personal pronouns (i.e. I, me, we, us, our). This is probably the hardest aspect of report writing to master and for most people will take much practise to perfect.

<table>
<thead>
<tr>
<th>Instead of...</th>
<th>Use in preference...</th>
</tr>
</thead>
<tbody>
<tr>
<td>workman</td>
<td>operator/employee</td>
</tr>
<tr>
<td>(to) man</td>
<td>staff/operate/use/work/direct</td>
</tr>
<tr>
<td>man hours</td>
<td>operating hours/working hours</td>
</tr>
<tr>
<td>man power</td>
<td>staff/workforce/personnel</td>
</tr>
<tr>
<td>men on machine</td>
<td>person on machine/operator on...</td>
</tr>
<tr>
<td>tradesman</td>
<td>maintainer/tradesperson/carpenter...</td>
</tr>
<tr>
<td>workmanship</td>
<td>work skill/skill/quality of output</td>
</tr>
<tr>
<td>chairman</td>
<td>chairperson</td>
</tr>
<tr>
<td>foreman</td>
<td>supervisor/superintendent</td>
</tr>
<tr>
<td>businessman</td>
<td>business executive/business person</td>
</tr>
</tbody>
</table>

Table 10

A list of some discriminatory terms that should be avoided and the preferred alternatives in the workplace.
The aim is that this writing style is to create a formal and objective tone. This is meant to be achieved on two levels. First it is intended to create a sense that the writer is separate from the subject matter and has objectively analysed the information; that there is no apparent bias or ownership that might influence the nature of any conclusions presented in the report. Secondly, it also is intended to separate the writer from the reader so the use of emotive language should be avoided that might otherwise unduly influence the reader.

Unlike what might occur in other forms of writing, reports should focus on conveying factual information rather than expressing personal opinion, information that is backed up by data, analysis, modelling and reference to other supporting information sources.

An often used expression is “the facts should speak for themselves.” Be aware though that different conclusions can be reached depending on what combination of facts are presented to the reader and how they presented. To avoid the report being cast as biased requires an attempt to fairly present all known facts unless the reasons for being selective are clearly stated.

Sometimes awkward sentence structure can arise when you write about actions and events without referring directly to who or what was involved. In such cases choose a sentence structure that gives the most clarity and conciseness. For example consider the following three sentences:

- "It was observed that the deviation was large." (passive, person unknown)
- "A large deviation was observed." (passive, person unknown)
- "I observed a large deviation." (active, first person)

The first sentence is ambiguous and wordy. The second sentence is concise but who observed the deviation? In the third sentence it is clear who did what.

If it is important for the reader to know that you or your project team members performed some task or hold a particular opinion, then use the first person in an active clause.

These aspects of style are illustrated in Tables 11 and 12.

Be clear

Avoid being unclear and ambiguous. This can happen when you do not specify what you are writing about and can even depend on how you use words such as ‘it’, ‘this’, ‘thing’, ‘way’, ‘someone’ etc as illustrated in the following sentence.

“Day (1983) suggested a new way to make a clear TiO₂ solution.”

The word ‘way’ is vague and should be replaced with ‘method’, ‘procedure’, or ‘technique’.

Be correct

Check that your spelling, punctuation and grammar are correct. If using a spell checker, be careful which word you select. Many inconsistent and easily corrected errors will affect the report’s overall presentation.

Sometimes you can see errors more easily if you do not proof read your writing until a day or two after finishing the draft. This is called ‘the bottom-draw treatment’ referred to earlier.

Many universities have department that assist students improve their communication skills and provide useful resources. For example the Learning Centre at UNSW has many online resources on topics including punctuation, grammar and spelling that can be used to improve written expression.
Check for jargon

Jargon is language and acronyms related to a particular field of knowledge or activity. Jargon is commonly used when communicating with others in that field. Communication problems arise when jargon is used in reports aimed at a more general audience.

Jargon can also include sub-technical words. This can cause confusion as some words will have a different meaning depending on the context. For example the word ‘fast’ has specific meanings in medicine (resistant to), mining (a hard stratum under poorly constructed ground) and painting (colours not affected by light, heat, or damp). Stress and strain to an engineer has a different meaning to a person with a medical background.

Endeavour to write for your intended audience. If the report is for your supervisor or a mining colleague then the use of jargon may be both appropriate and expected. If, however, you are writing a report for a more general audience, jargon should be avoided with simple, clear descriptions used instead.

Engagement of the reader

You may have noticed that the style of writing used in this document conflicts with the previous statements on writing style.

In this case, a writing style was deliberately chosen which is more personal and would (hopefully) engage the reader.

To illustrate how the same message can be written in different styles, consider the following three passages from a document. Though the message is the same, the level of warmth and engagement differs between the three versions.

Current report style:

“This document has been prepared to help you, the student, to write better reports. It is not intended to constrain your creative talents but to outline the accepted norms and standards of structure, format and style used in technical report writing.”

A technical report style:

“This document has been prepared to help the student write better reports. It is not intended to constrain the student’s creative talents but to outline the accepted norms and standards of structure, format and style used in technical report writing.”

An alternate technical report style:

“This document is intended to improve the quality of report writing; it is not intended to constrain creative talent. The document outlines the structure, format and style used in technical writing.”

Lists of information

Reports frequently use lists to clarify and/or to emphasise information. They are also used to succinctly summarise information. There are several ways to form a list in a report; three of the more common forms are featured.

The first form is as a continuous sentence. In this case each item in the list begins with a lower case letter and ends with appropriate punctuation as shown in the following example.

“A Ross chain feeder was chosen because
• previous experience was satisfactory,
• evacuating costs were less, and
• an over-type feeder required less maintenance.”

The second form of list is a collection of individual sentences. The opening sentence ends with a colon and each subsequent line finishes with a semi-colon as shown in the following example.

“The trucks had three distinct features, these being:
• the tipping wheels are projected;
• the doors are rigidly attached to the suspension arms; and
• the suspension arms are anchored to the chassis.”

The third form of a list is an inventory. Here each item in the list begins on a new line with a lower case letter with no punctuation until the end.
“The equipment required for efficient operation is listed below.

- wide throat 200 mm idler blocks
- 12 V sealed beam lights
- screens to protect the operator.”

There should be a logical order to the sequence of items in the list. This could be moving from general to specific, most important to least important, largest to smallest component, and so on. A numbered list is useful if a sequence or series of steps applies to the points in the list.

**Parallel rule**

To ensure lists and bullet points score well on the readability index apply the *Parallel Rule*. The Parallel Rule entails using a similar grammatical pattern to make a list. The writer begins each new item in the list in a similar manner. In Table 12, points a), b) and c) each begin with ‘To provide …’ The bullet points under point a) also share a similar grammatical pattern each beginning with a definite noun *the key, the actions, the roles* and so forth.

**Spelling of technical terms**

As with many forms of human activity a range of specialist terminology has evolved to describe unique aspects of the mining environment such as adit, shaft, decline for different means of access to an underground mine and crib for a meal break.

Unfortunately for new entrants to the industry, use of the terms can differ between the different sectors in mining, for example “roof” is often used in underground coal mining whereas “backs” is more often used in hard rock mining. Aside from different mining sectors, terms can vary geographically for example to undertake mineral exploratory activities in New South Wales an Exploration Lease is required whereas in Queensland, an Exploration Permit is needed.

It is important to use the correct term appropriate to the context.

The internet can provide links to many mining dictionaries, glossaries and other resources that can help explain many of these terms. A link to some of these resources can be found on the AusIMM web page.

**Table 12**

An example of a “clear” piece of writing.

<table>
<thead>
<tr>
<th>Lecturer’s Comments</th>
<th>RISK MANAGEMENT PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>This section of text is easy to read. Each point is expressed simply and clearly. Other strengths in the text include:</strong></td>
<td><strong>The specific objectives of the plan are as follows.</strong></td>
</tr>
<tr>
<td>• the points follow the Parallel Rule;</td>
<td>a) To provide a framework for management to address major risks associated with both options as determined by previous risk reviews. The Risk Management Plan will therefore include:</td>
</tr>
<tr>
<td>• the points are logically sequenced; and</td>
<td>• the key areas to be addressed;</td>
</tr>
<tr>
<td>• the sentences are clear and concise.</td>
<td>• the actions to address the key risk areas;</td>
</tr>
<tr>
<td></td>
<td>• the roles and responsibilities within relevant organisations; and</td>
</tr>
<tr>
<td></td>
<td>• the means for monitoring and review of the actions.</td>
</tr>
<tr>
<td></td>
<td>b) To provide a document that has practical value to persons involved in its implementation and is suitable as an introduction to the driving of a decline.</td>
</tr>
<tr>
<td></td>
<td>c) To provide the initial basis for The Risk Management Plan, for which detailed content can be updated to accommodate any future requirements arising from changing circumstances or improved knowledge. In other words, the document is intended to be ‘live’ and reflect changes when needed.</td>
</tr>
</tbody>
</table>
Appendix 4 contains examples of spelling and hyphenation of some technical terms used in the mining industry; for example terms such as ore body or orebody, in situ or in situ, cutoff grade or cut-off grade; in each case the latter is the recommended spelling according to the Guide to Authors.

**Shortened words and phrases – abbreviations and acronyms**

In general, abbreviated forms of words and phrases such as NPV and W.A. are often used in formal report writing. However use of grammatical contractions such as don’t, can’t and it’s are discouraged in reports as these are ‘spoken forms’ of expression. Formal writing at university and in the workplace requires use of the non-abbreviated form (e.g. does not, cannot, it is, they are).

Whenever a non-standard shortened form of a word or phrase is used for the first time then the full name must be provided followed by the shortened form enclosed within brackets. Subsequently only the abbreviated form need be used in the report. An example of the use of an initialism in a report is illustrated in the following sentence.

“...the mine uses load haul dump (LHD) machines for materials haulage underground... The haulage fleet consists of 10 LHDs...”

**Abbreviations** consist of the first few letters of a word but do not include the last letter. An abbreviation is usually terminated by a full stop, for example Co., Min. and Vic. Note if the abbreviation ends the sentence as in the last sentence (Vic.) then only one punctuation mark is necessary.

**Contractions** like abbreviations are a shortened form of a word but consist of the first and final letters of a word and do not require a full stop, for example Ltd, Rd, Qld.

Phrases that are referred to more than once in a report can also be shortened. One method of shortening called an **acronym** consists of the first letter of each word formed so that the

---

**Table 13**

Punctuation conventions.

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Function</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full stop</td>
<td>.</td>
<td>To mark the end of a sentence.</td>
<td>The overburden is comprised of soft shale with a strength of 25 MPa.</td>
</tr>
<tr>
<td>Colon</td>
<td>:</td>
<td>To introduce a list.</td>
<td>Worksite inductions are important for three reasons:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• in an emergency …;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a fire would...;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• newly ‘inducted’ workers…</td>
</tr>
<tr>
<td>Comma</td>
<td>,</td>
<td>Separates information into readable units.</td>
<td>The Eocene coals, which formed in an extensional structural setting under a transgressive depositional environment, are characterised by higher levels of ash and sulphur, and by generally thin or intermediate seam thickness, typically four to six metres in the economic deposits.  (Friederich, Langford and Moore, 1999)</td>
</tr>
<tr>
<td>Apostrophe</td>
<td>’</td>
<td>Used to indicate ownership (whose) with nouns.</td>
<td></td>
</tr>
<tr>
<td>Quotation</td>
<td>“…”</td>
<td>Indicates that the words enclosed in the</td>
<td>Brake and Bates (1999) believe that these seams “may have resulted from the domed typography”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>quotations are from another source and are</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>quoted exactly as in the original source.</td>
<td></td>
</tr>
<tr>
<td>Hyphen</td>
<td>-</td>
<td>Joins two words to create a single idea. Used when the spelling of two joined words would be awkward or obscure the meaning. Use only when necessary.</td>
<td>• free-settling particle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• liquid-solid separation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• sink-float system</td>
</tr>
</tbody>
</table>
shortening is pronounced as a word such as JORC (Joint Ore Reserves Committee) and ACARP (Australian Coal Association Research Program).

An alternate form of shortening of a phrase is called an initialism. Here each letter in an initialism is pronounced separately such as EIS (environmental impact statement), IRR (internal rate of return) NPV (net present value) and UNSW (University of New South Wales). Ordinarily each letter in an initialism is capitalised.

Symbols are another category of the shortened form of words and concepts that include for example “&” and “@.” Except for units of measurement, their use is discouraged in the running text of a report however they can be used where space is limited such as in tables. See the section Symbols for units of measurement in Chapter 5 for further details on symbols and measurement.

There are other shortened forms of a word or phrase that do not follow any of the usual conventions but are commonly in use. For example the term “ytd” is similar to an initialism but it is often not capitalised. This is pronounced as year-to-date rather than each letter read out separately as is the case of an initialism. These should be treated as a symbol and not used in the running text of a report but restricted to tables.

Another category includes the shortened form of Latin words or phrases. This includes for example:

- c. (circa, about, approximately);
- cf. (confer, compare);
- e.g. (exempli gratia, for example);
- etc. (et ceteria, and so forth, and so on);
- i.e. (id est, that is);
- v., vs (versus, against); and
- viz. (videlicet, namely).

The use of the last category of the shortened form is again discouraged in the running text of a formal report. But as with symbols they are permissible where space is limited as in tables or when enclosed within brackets (e.g. the examples provided in this document).

When using abbreviations, the Guide to Authors recommends using minimal punctuation except to indicate the end of a sentence.

For further detailed discussion on capitalisation, plural and possessive forms, punctuation and other categories of the shortened form (e.g. time and geographical features) see Chapter 10 in the Style Guide.

Appendix 5 contains a list of some commonly used abbreviations in the mining industry.

Punctuation

Minimal use of punctuation is often preferred and has become the norm in report writing. Understanding when and how to use punctuation helps you express ideas clearly. Some examples of correct use of punctuation are provided in Table 13.
When should material be referenced?

Whenever information or other material contained in a report was obtained either directly or indirectly from a textbook, journal, conference paper, another report or from any other source then sufficient details must be provided to allow the reader to access that material.

This requirement encompasses all types of information including a direct quotation, paraphrased and summarised information; a sketch, plan and other types of illustration; and, numerical data and tables.

Why should I reference material anyway?

Referencing is the general term used to describe the process of providing the source information. It is usually done in a systematic manner and is intended to acknowledge the origin of the information, data or illustration.

An important benefit of referencing material is that it demonstrates the student has undertaken research on a particular topic which is often one objective of an assignment. This can be especially important in assignments where the student has been asked to undertake research on a topic.

Whereas if a student fails to acknowledge the source in a report or other student assignment then the implication is that it is the student's own original material. This is considered as plagiarism which is a serious form of academic misconduct that can result in severe consequences for the student. Plagiarism is defined as “...using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement” (UNSW, 2013c).

Acknowledging the work of others is a practise that you are expected to adopt while at university. And it is a practice that you are expected to continue in your professional career.
Finally, referencing the work of others is part of good academic behaviour. Each university has an expected level of student behaviour often defined in a policy statement. For example at UNSW this behaviour is defined in the *Student Code Policy* (UNSW, 2013a). It is expanded in the document titled *Ethical Use of Scholarly Material* (UNSW, 2013b) that states in part:

“Students must observe academic conventions in the ethical use of the materials of others. Maintaining standards in scholarship requires a commitment to scholarly values. Among such values is the adherence to ethical behaviour.

Many aspects of ethical behaviour come together in the process of research and, in particular, in the use of scholarly materials. In the interests of maintaining high standards in scholarship and research, the University reminds students that when they are completing assignments, conducting research and writing theses, they are ethically bound:

- to cite the published source, to acknowledge the originator of substantial ideas upon which they are building their work, and to acknowledge quotations by the use of quotation marks...”

**Further information on plagiarism**

For students enrolled at *Curtin University*, relevant information on plagiarism can be found at:

- Academic misconduct and plagiarism at <http://policies.curtin.edu.au/policies/students.cfm>

Students enrolled at *UA* will find relevant information on plagiarism at:

- Plagiarism policy and guidelines at <www.adelaide.edu.au/policies/?230>
- Plagiarism and copyright information for Students at <www.adelaide.edu.au/clpd/plagiarism/students>

Students enrolled at *UNSW* will find relevant information on plagiarism at:

- Plagiarism at <https://student.unsw.edu.au/plagiarism>

Students enrolled at *UQ* will find relevant information on plagiarism at:

- Academic integrity and plagiarism at <www.uq.edu.au/myadvisor/academic-integrity-and-plagiarism>
- What is plagiarism at <www.library.uq.edu.au/training/plagiarism.html>

**Which sources of information provide good reference material?**

While students are encouraged to seek out information from various sources, not all sources of information necessarily provide reliable or independently verified reference material.

The student has to be discerning in their choice of reference sources that they use in reports or indeed any other assignments. They should not just select the first or most easily accessible pieces of information that come to hand such as material on the internet.

Identifying sources of information is only part of the story, assessing the reliability of that source must also be done as it can either lend weight to or retract from the argument or discussion.

The student needs to develop skills to identify which are the most reliable sources, much of which comes with experience. The objective being to identify those sources where the information has undergone a process of independent verification preferably by appropriately qualified persons.

In order to assist the student in this task, a five star rating scheme has been developed ranging from 5 Stars for the most reliable of sources to 1 Star being the least reliable sources. Underpinning each category in the star rating is a set of criteria with examples provided. The student is cautioned against blindly following the scheme as by necessity some generalisations have been made which might not apply in all circumstances. What is more important is the
student understands that there are differences in the reliability of information and in the end the student must apply their own judgement to determine which are the most appropriate sources to obtain reference material for a particular report.

**Five stars**

By definition the top rating category is reserved for those sources of information which are usually found to be the most reliable. These sources will have well developed systems in place to ensure the information provided has been reviewed, the methods used to obtain the results are transparent and there is a lack of any undue influence on the conclusions and outcomes and, all this has been independently verified.

Within this category are the scholarly journals. These will have an established independent peer review process in place to critically review material before its publication; independent here meaning independent of the author.


The same level of reliability can often be attributed to books which are produced by commercial publishers. These too will have established review and editorial processes in place.

This category includes the most reliable sources of information for use as reference material in reports and assignments. Because of this association, the information is generally regarded as being authoritative and the publications termed refereed journals and books.

**Four stars**

Next rung on the rating's ladder is information provided in published conference proceedings which are organised by professional bodies and learned societies. These conferences have a panel of independent reviewers who are usually specialist in their field that examine each work before it is published in the proceedings. Hence the term refereed conference proceeding is used. To ensure transparency, the names of the reviewers are usually listed in the proceedings. Examples of such conferences are those organised by or under the auspices of the AusIMM, SME, *International Society of Rock Mechanics (ISRM)* as well as universities and the specialist conference organisers such as the *Application of Computers and Operations Research in the Mineral Industry (APCOM)* and, *Mine Planning and Equipment Selection (MPES).*

Also included in this category are universities, research and other similar organisations. Often the information from these organisations is published in journals, conference proceedings and/or books but it can also be made available directly by the organisation in the form of reports of investigations or project reports. Usually these organisations will have established internal review processes involving relevant professionals to vet the information before it is released. This material is often available to the public and can be found in major libraries. Here their is an onus on the organisation to ensure the information made available is reliable and credible as it can reflect on its reputation.

Examples of these information sources are reports by the Australian Coal Association Research Program (ACARP), the Minerals and Energy Research Institute of Western Australia (MERIWA), CSIRO, and the US Bureau of Mines in their Reports of Investigation as well as governmental departments, authorities and institutions. This also includes university theses (Honours, Masters and PhD) by mining departments/schools for example at Curtin, UA, UNSW, UQ, and overseas.
### Three stars

This category is reserved for those sources which either have not been independently reviewed; or, lack transparency about the veracity of the information.

These factors could be due to commercial, strategic and marketing considerations.

But again this is balanced by the potential negative impact on the organisation's reputation. As well, the information released into the public domain can be subject to scrutiny by regulatory bodies in some instances. Hence for the most part the information should be reliable and can often be used as reference material but care should be exercised when using it.

This category includes trade journals and magazines which can include advertising material. These are usually only reviewed by the magazine editor who may not be an expert on the topic. The category also includes publications from companies and non-refereed journals and on-line journals. Examples include company annual reports and internal reports. *While often useful the information needs to be cross-checked.*

### Two stars

This category includes sources containing what appears to be technical writing including papers and reports but where there is no apparent system of independent review of the information. The implication being some or all of the information may or may not be correct.

Typically this will include sources on the internet belonging to an individual or unincorporated organisation. It also includes unpublished papers or reports and, papers from conferences that have not been peer reviewed.

Since there can be a question as to whether the information has been independently verified, its reliability for use in reports and assignments is questionable. These are not recommended to be used as principle sources but if they are *used then the information should not be used in isolation* but preferably reinforced by more authoritative, higher ranked sources.

### One star

The final ratings category includes open or collaborative sources of information prevalent on the internet such as Wikipedia. More often than not the processes of verification are not always stringently applied if they exist at all. Hence the information can be unreliable or perhaps misleading. While these sources might be useful in providing background information and may lead to information from other more reliable sources, *they should not be used as reference sources in a report.*

This category also includes sources that cannot be attributed to either an individual, group or organisation and where no details are provided about where or how the information was derived. An example of this might be a web page which has no affiliation to a company/organisation and/or no contacts and/or contains links to advertising material.

As the information can be incorrect, plagiarised and/or poorly written, these are the least reliable sources and *must not be used as reference sources in a report.*

### Implications for the student

Before the advent of the internet, the range of reliable information sources was usually limited to books, journals and conference proceedings making the process of filtering information fairly straightforward even though getting access to the information was often time consuming.

Now as information is more readily accessible on the internet and search engines can quickly point to related information using keywords, the process of gathering information has been greatly simplified. In fact it could be said the pendulum has swung so far to the other extreme that perhaps the student is now in a state of information overload with a huge variety of potential reference sources some often being a rehash of the same information but which also includes less reliable information. So much so that a large period of time must be spent in filtering out unreliable sources and distilling the relevant elements for a report.
In summary, when preparing a report the student has to: discriminate between information sources based on these guidelines; and, select those sources that are more likely to provide reliable information as reference material.

How should I reference material in a report?

The most common style or system used in science and engineering publications to acknowledge or cite the source of reference material is the author-date system.

There are many variants of this system in use each exhibiting varying levels of difference. Many of these have been developed by professional societies, institutions and publishing houses. The system is also known as the Harvard referencing system though this is discouraged in favour of the term author-date.

In all reports for MEA courses, the student must use the particular variant adopted by the AusIMM as detailed in the Guide to Authors. Use of any other variant will be considered as noncompliant and penalty marks are likely to be applied.

What information must be provided when referencing?

As with many referencing systems, there are two parts to the system. The first is a shorthand notation or in-text citation of the reference source contained in the body of the report - the author and year. This citation provides a link to the full bibliographic details that are listed alphabetically in the references section at the end of the report.

**Citation in body of report**

A citation consisting of the family name of the author or authors and the year of publication are placed near to where the material is used in the report; note the initials of the author are not included.

Depending on the structure of the sentence, the author(s) may or may not be enclosed within round brackets while the year is always placed within brackets. Some examples of the author-date referencing system in a report are as follows.

- **Single author**
  
  “Following analysis of the results of the core cuttability test work, Roxborough (1988) found a correlation between...”

- **Single author - alternate**
  
  “…a reasonable prediction as to the performance of a roadheader machine (Roxborough, 1988).”

- **Up to and including three authors**
  
  “…Rogers, Jones and Hart (1978) confirmed the inverse relation between...”
  
  [Note the names of all three authors are included in the in-text citation.]

- **Four or more authors**
  
  “…when taking measurements with the Schmidt Hammer (Golder et al, 1982).”
  
  [Note only the name of the first author is stated followed by the expression et al in the in-text citation. See the later section titled Multiple Authors for further details.]

- **Multiple sources of information**
  
  “…the forces in cutting vary with penetration (Roxborough and Phillips, 1974; Hood, 1990; Bilgin, 2003).”
  
  [Note each citation is separated by a semicolon and sorted by year or by name.]

- **Author and page numbers**
  
  “Following analysis of the results of the core cuttability test work, Roxborough (1988, p. 24) reported...”

  “…in taking measurements with the Schmidt Hammer (Golder et al, 1982, pp 45-47).”

The latter form of in-text citation is used when it is necessary to highlight a particular section in the source for example (i.e. page numbers).

**Details in references list**

The second part of the referencing system is the full bibliographic or publication details of the reference source. These details are listed alphabetically within the references section of the report. The list is sorted first alphabetically by author and then by year of publication; see the section on References in Chapter 4 on Report structure.
In the case of some of the example citations given earlier, the corresponding bibliographic details as they would appear in the references section of a report would be:


These reference sources are examples of a book, journal paper and conference paper respectively, the latter usually published in the proceedings of a conference.

**What must be included in a references list?**

**A references list**

The list in the references section must only contain details of sources that have actually been cited in the report. If no citation to source is stated in the body of the report then it is not a reference source and its details must not be included in the list of references.

The bibliographic details must include the names of all authors; the term et al should not be used. Hyperlinks to publication details that are usually evident by words being underlined or in a different font colour must be removed. To remove a hyperlink from a reference listing, first highlight the hyperlink then right-click and select <Remove Hyperlink> from the list of available options.

**A bibliography**

Occasionally an assignment might require the student to include a list of readings or other information sources that may have been referred to in preparing an assignment but which may not have actually been cited in the assignment. In this case a separate list of publication details should be created in a separate section headed Bibliography.

A bibliography is not a substitute for a reference list. It is not usually found in technical reports and should NOT be included in most MEA assignments unless specifically requested in the assignment briefing.

**Primary and secondary reference sources**

It is always preferable to cite the original that is the primary reference source of information in a report.

In some situations, information found in a publication may refer to an earlier work by the same or different author, this is called a secondary source.

While it is preferable to find and confirm this information in the primary source, it might not always be possible such as in the case where the original publication is out of print or no longer publicly available or, where the information is written in another language.

Two examples of how this can be done in a report are:

“...acoustic emissions are generated in a material when it is subjected to stress (Kaiser, cited in Hardy 1981)...”

“Kaiser (cited in Hardy 1981) stated that acoustic emissions are generated in a material when subjected to stress...”

The corresponding bibliographic details in the references section would contain details of the secondary author, for example


**Some examples of referencing**

Two examples of in-text referencing are provided in Table 13. The paragraph that includes a
reference to the work of Brake and Bates published in 1999 is an example of a direct quotation with words from the referenced material enclosed within quotation marks. While the paragraph referring to work on Eocene coals is an example of paraphrasing.

Even when a student summarises ideas or concepts from another source in their own words (or paraphrases) they are still required to reference the original source. Two examples of how to reference paraphrased information include:

“Keilblock et al (1998) simulated an ERS door being opened 30 times…”

“The oldest known sediments with reliable dates are of middle Eocene age, although it is possible that deposition may have begun earlier than this (Hutchison, 1996).”

See the following section on Multiple Authors for the correct use of the term et al.

The following sections provide examples of referencing different types of information that can sometimes be found in reports. The student should note the order in which the publication details are presented, font styles and what punctuation marks are used. These must be followed verbatim.

Further examples on referencing are provided in Appendix 1 as well as in the references section of the sample report shown in Appendix 2 and the Conference Paper shown in Appendix 3.

An extensive discussion of the author-date system together with numerous examples for different media can be found in Chapter 12 Methods of Citation of the Style Manual.

Multiple authors

If a reference source has fewer than four authors (that is three or less authors) then the names of ALL authors must be stated in the citation. An example of an in-text citation having three authors is:

“Lawrence, Smith and Jones (1988) found the major parameters…”

In instances when there are four or more authors then the term et al is used. It is a Latin phrase meaning “and others.” The term is used immediately following the name of the reference’s first author. Regarding punctuation, the Guide to Authors recommends et al not be followed by a full stop. Two examples of an in-text citation having four or more authors are:

“Mining dilution can vary significantly between mining systems (Gordon et al, 1995).”

“In the paper, James et al (1995) noted…”

The publication details contained in the references section, however, must list the names of ALL the authors. Hence the term et al should not appear in the references section of a report.

Multiple reference sources

In some instances it might be required to note more than one reference source to support an argument, concept, issue etc. Citing multiple reference sources is useful particularly if the issue might be contentious. In this case all the references should be enclosed within the one set of round brackets, each one separated by a semicolon, for example:

“…analysis of water samples indicated high levels of dissolved metals (Joghson, 1996; Neval and Smith, 1990; Williams et al, 2001).”

Multiple publications by an author in the same year

Whenever two or more references are attributed in a report to the same author that were published in the same year then to distinguish each citation a lowercase letter is added following the year of publication, for example:

“Haas (1981a; 1981b) has shown…”

Details found in the references section would be:


Chapter 7: Referencing

Long author names

Sometimes the name of the author can be long especially if it is the name of an organisation. In instances when long authors are cited on more than one occasion then the naming convention for abbreviations as discussed in Chapter 6 can be adopted, for example:

“…one of the high priority research areas identified by the Australian Coal Association Research Program in 2010 was… (ACARP, 2010).”

The reference list should contain the publication details following the full name of the organisation not its abbreviated form. But the abbreviated form as used in the citation should be included in the reference list with a cross-link to the full author name, as for example;

ACARP—see Australian Coal Association Research Program

Discussion or interview

Sometimes the only available source of information might be an interview, meeting or telephone call etc. It is preferable not to use this as a reference source as the source or information might prove difficult to corroborate. Where no other sources are available, it may be necessary for example when it is a unique observation though it is preferable to quote other reference sources. This type of source is termed Personal Communication. Before being used in a report it is important permission is gained from the relevant person(s) to cite them as a reference source.

Two examples of citing personal communication in the running text of a report include:

“Discussion with Mr G Andrews on 18 October 2006 confirmed…”

“Mr J Smith (2006) has observed…”

Unlike the usual convention, the person's title and initial are included in the in-text citation in this case.

The corresponding citation in the references section would be:


Information obtained from a website

When information is obtained from the internet then the bibliographic details must include the name of the document, the address of the website and the date when the information was accessed.

Generally only the Uniform Resource Locator (URL) for the site home page of the reference source need be included. Do not include the search result URL (e.g. that provided by Google) as it is not the address of the actual source and the search address can often be quite long.

If the URL of the information being cited is reasonably short, that is less than one line, then the full URL may be included. Some alternate methods of referencing information from websites are as follows.

Preferred


Allowable


Not acceptable

Note the use of angle brackets (<>) to signify a web address. See Appendix 1 for further examples of referencing information from electronic sources.

**Printed vs on-line material**

In situations where published information is also made available on the internet such as a journal article or conference proceeding, it is preferable to provide the details of the original publication in the normal manner in addition to the internet address. Stating only the internet address of the journal article is not acceptable especially if the internet site is restricted and only available through a service provider such as a university library that is not accessible to the general public.

**Preferred**


**Alternate**


**Not acceptable**


**Information obtained from data storage media**

When information is obtained from a document stored on a CD/DVD-ROM, USB flash drive or other electronic media rather than a hardcopy publication then it is listed in a manner similar to a conference proceeding, for example:


**Lecture, seminar or workshop**

When referencing information provided in a lecture or presentation then state the name of the person who gave the lecture and the year in the usual manner in the running text of the report. The listing in the references section should include the name of the lecture, the venue where the lecture was delivered and the date of the lecture. Two examples of this type of information source are:

Laurence, D, 2008. Challenges and opportunities for sustainable mining practices in the Asia-Pacific Region. 11th Kenneth Finlay Memorial Lecture delivered at Law Library, University of New South Wales, 23 October.

Ker, C, 2006. Approaches to mine planning. Presentation to UNSW students at offices of Perilya Broken Hill, 12 August.

When quoting information, tables or figures from a transcript of a lecture then reference the source material in the usual manner.

**Legislation**

The convention when referring to legislation for the first time in a report is to use the short title of a legislation together with the year written in italics. The name of the legislation is followed by the jurisdiction in brackets, for example:

“…the use of stop orders by the responsible Minister are outlined in the *Coal Mine Health...*
Chapter 7: Referencing

The student must decide whether the information is credible, valid and/or relevant before using it as reference source in a report. If you have cross-checked and verified the source is credible but there is no obvious author then use the title of the document or web page in place of the author followed by the year and other publication details.

Managing references

In large reports and in theses, managing references can become tedious and mistakes may be made as new references are added to the list, especially for multiple publications in the same year.

Various software tools such as EndNote, RefWorks and Zotero are available that can make this process easier to manage. At some universities such software is provided to students in which case they are encouraged to use it as early as possible in their studies so as to become proficient in its use by the time they come to write their thesis.

A word of caution. Most software tools do not by default recognise the AusIMM variant of the author-date system and may require some adjustment before it can be used correctly. While tools such as EndNote can assist in writing a report, in the end the author(s) is ultimately responsible for the quality of the content and its presentation in the report.

Summary

A student must always acknowledge the source of any information or material contained in a report that is not their own original work using the author-date system. This is whether it is a direct quotation or paraphrased, table, illustration or some other material. The name of the author(s) together with the year of publication should be cited in the body of the report next to where it is used and the full publication details of the source material listed alphabetically in the references section of the report.
References


Other useful references


Appendix 1

Examples of referencing various types of information sources
Listing of reference media types

**Information obtained from hardcopy sources**

- An article in a journal
- A book
- A chapter or paper by an author in a book edited or compiled by others
- A paper in a conference proceedings
- A thesis
- A map
- An article in a magazine, newspaper or other periodical
- Printed material with a restricted or intermittent circulation
- Patent and patent application
- Material accepted for publication but not yet published
- Public lecture, seminar or workshop
- Personal communication
- A manuscript in preparation
- An author with two publications in the same year

**Information obtained from electronic media sources**

- A paper available on an on-line journal
- Document available from a website
- Paper presented at a conference or workshop but not published
- Document from a data storage media – a CD/DVD ROM, USB flash drive
- JORC Code
- Electronic book
- Online press release
- Film, video, television or radio program
- Online video
- Podcast
- Online illustration

The five star rating scheme referred to in Chapter 7 has been included in this list where appropriate. Caution should be exercised as the rating applies to the generalised case and may not be applicable in all circumstances.

Note:
- **TCC** - *Title Case Capitalisation*: where most words are capitalised in a sentence such as the title of a book.
- **SCC** - *Sentence Case Capitalisation*: only the first letter of the first word in a sentence is capitalised as in the title of a paper.

In both cases, the usual conventions for capitalisation should be applied such as capitalise proper nouns.

**Information obtained from hardcopy sources**

**A1. An article in a journal**

- Family of the author;
- Initials of the author;
- Year the article was published;
- Name of the article (SCC);
- Name of the journal, magazine, newspaper or other periodical (TCC, in italics);
- Issue or volume number. This could be the month for a monthly publication or the year for an annual publication;
- Sequence number within the particular volume (number is enclosed in brackets);
- Page numbers of the article in the journal.

**Reference syntax**: 1, 2, 3, 4, 5, 6(7):8.

1. Family of the author;
2. Initials of the author;
3. Year the article was published;
4. Name of the article (SCC);
5. Name of the journal, magazine, newspaper or other periodical (TCC, in italics);
6. Issue or volume number. This could be the month for a monthly publication or the year for an annual publication;
7. Sequence number within the particular volume (number is enclosed in brackets);
8. Page numbers of the article in the journal.

**Examples:**

A2. A book

Reference syntax:

1, 2, 3, 4, 5 (6: 7).
1. Family name of the author;
2. Initials of the author;
3. Year the book was published;
4. Title of the book (TCC, in italics);
5. Pages of the book where the information came from or number of pages in book;
6. Publisher of the book;
7. City where the publisher is based.

Examples:

A3. A chapter or paper by an author in a book edited or compiled by others

Reference syntax:

1, 2, 3, 4, 5 (6: 7).
1. Family name of the chapter or paper author;
2. Initials of the author;
3. Year that the compilation was published;
4. Title of the chapter or paper (SCC);
5. “in”
6. Title of the book or compilation (TCC, in italics);
7. ed;
8. Initials of the book or compilation editor;
9. Surname of the book or compilation editor;
10. Pages of the proceedings used;
11. Publisher of the proceedings;
12. City where the publisher is based.

Examples:

A4. A paper in a conference proceedings refereed

Reference syntax:

1, 2, 3, 4, 5 6, 7 (8) 9 (10:11).
1. Family name of the paper author;
2. Initials of the author;
3. Year that the conference was in;
4. Title of the paper (SCC);
5. in;
6. “Proceedings” then the name of the conference (TCC, in italics);
7. City and country in which the conference was held;
8. Editor of the proceedings;
9. Pages of the proceedings used;
10. Publisher of the proceedings;
11. City where the publisher is based.

Examples:
A5. A thesis

Reference syntax:

1. Family name of the thesis author;
2. Initials of the author;
3. Year that thesis was completed;
4. Title of thesis (SCC);
5. Type of thesis – honours, or PhD;
6. Published or unpublished – usually the latter;
7. Name of the supporting institution;
8. City of this institution.

Example:

A6. A map

Reference syntax:

1. Family name of author of the map;
2. Initials of the author;
3. Date the map was drafted;
4. Region of the map (in italics);
5. State the region is in;
6. Scale that the map is to;
7. What the map is showing;
8. Publisher of the map.

Example:

A7. An article in a magazine, newspaper or other periodical

Reference syntax:

1. Family name of the author;
2. Initials of the author;
3. Year the article was published;
4. Name of the article (SCC);
5. Name of the journal, magazine, newspaper or other periodical (TCC, in italics);
6. Issue or volume number. This could be the month for a monthly publication or the year for an annual publication;
7. Sequence number within the particular volume (enclosed in brackets);
8. Page numbers of the article that were used.

Examples:

A8. Printed material with a restricted or intermittent circulation

Generally the same reference syntax is used whatever the source but it does not contain any italicised component and whenever possible it contains the document number at the end of the reference.

Examples:
AMIC—see Australian Mining Industry Council.
BSI—see British Standards Institute.
Came, J E, 1911. The tin mining industry and the distribution of tin ores in New South Wales, NSW Department of Mines, Sydney, Mineral Resources Rpt No 14.
A9. Patent or Patent application

Reference syntax:

1. Family name of the author;
2. Initials of the author;
3. Company that will own the patent;
4. Date that the patent was lodged;
5. Name of the patented work (SCC);
6. Name of the panel providing the patent (TCC);

Examples:


A10. Material accepted for publication but as yet not published

Use similar syntax as for a published reference source except substitute the expression “in press” in place of the year of publication.

Example:


A11. Public lecture, seminar or workshop

Reference syntax:

1. Family name of the presenter;
2. Initials of the presenter;
3. Year that the presentation was given;
4. Title of the lecture (SCC);
5. Subject or reason for the lecture occurring;
6. “delivered at”;
7. Venue where the lecture was given;
8. Name of the institution;
9. Date of the presentation.

Example:

Laurence, D, 2008. Challenges and opportunities for sustainable mining practices in the Asia-Pacific Region. 11th Kenneth Finlay Memorial Lecture delivered at Law Library, University of New South Wales, 23 October.

A12. Personal communication

Reference syntax:

1. Family name of the contact;
2. Initials of the contact;
3. Year in which the contact was made;
4. Personal communication;
5. Role of the contact within organisation;
6. Company the contact works for;
7. Date that the communication occurred.

Example:

Clark, I, 2003. Personal communication, Technical Services Superintendent, Coal Co of Myriad, 10 November.

A13. A manuscript in preparation

Reference syntax:

1. Family name of manuscript author;
2. Initials of the author;
3. “in prep”;
4. Title of the manuscript (SCC);
5. Name of the supporting institution;
6. City in which this institution is located.

Example:


A14. An author with two publications in the same year

The precise form is dependent on the source type however a suffix is added to the year of publication consisting of a lower case letter to differentiate the various publications. The corresponding suffix is used in the in-text citation.

Examples:

Information obtained from electronic media sources

E1. A paper available from an on-line journal

Reference syntax:
1. Family name of author/editor;
2. Initials of author/editor or organization;
3. Year the website information was last updated;
4. Title of the article or paper (SCC);
5. “online”;
6. Title of the journal (TCC, in italics);
7. Edition;
8. Place of publication;
9. Publisher;
10. “Available from”;
11. URL of website - homepage or, full address if of an appropriate length;
12. Date that the website was accessed.

Examples:

E2. Document available from a website

Reference syntax:
1. Author of the website or company name;
2. Initials of author/editor or organization;
3. Year the website information was last updated;
4. Name of page viewed (SCC);
5. “online”;
6. “Available from”;
7. URL of website - homepage or, full address if of an appropriate length;
8. Date website was accessed.

Examples:

E3. Information from a website

Reference syntax:
1. Author of the website or company name;
2. Initials of author/editor or organization;
3. Year the website information was last updated;
4. Name of page viewed (SCC);
5. “online”;
6. “Available from”;
7. URL of website - homepage or, full address if of an appropriate length;
8. Date website was accessed.

Examples:

E4. Paper presented at a conference or workshop but not published

Reference syntax:
1. Family name of the presenter of the paper;
2. Initials of the presenter of the paper;
3. Year presentation was given;
4. Name of the paper (SCC);
5. “paper presented to”
Appendix 1

6. Title of the conference;
7. City where the conference was held;
8. Date(s) of the conference.

Example:

E5. Document on data storage media including CD/DVD ROM, USB flash drive

This will follow the syntax for the corresponding hardcopy source except the term “[CD ROM],” “[DVD ROM]” or “[USB]” is inserted after the title.

Example:

E6. JORC Code

The Guide to Authors stipulates a standard form when referring to certain industry codes.

Example:

E7. Electronic book

Reference syntax:
1. Family name of the author or editor;
2. Initials of the author or editor;
3. Date the book was published;
4. Title of the book (SCC, in italics);
5. Pages of the book used;
6. Publisher of the book;
7. City where the book is located;
8. Available from;
9. URL where the book was made available;
10. Accessed;
11. Date the book was viewed.

Example:

E8. Online press release

Reference syntax:
1. Family name of author or speaker;
2. Initials of author or speaker;
3. Date of the press release;
4. Title of the press release (SCC, in italics);
5. Media release;
6. Available from;
7. URL where the press release was publicised;
8. Accessed;
9. Date press release was accessed.

Example:

E9. Film, video, television or radio program

Reference syntax:
1. The name of the program or film;
2. The year that it was recorded, broadcast or released;
3. Title of the story (TCC, in italics);
4. Type/format of media;
5. Name of the media organisation or distributor;
6. City or country where the organisation is based;
7. Date of recording.

Examples:
Appendix 1

My Brilliant Career, 1979. Motion picture, New South Wales Film Corporation, distributed by Australian Video, Australia.

E10. Online video

Reference syntax:
1. Name of the host show/program or film;
2. Year in which it was made;
3. Title of the video (SCC, in italics);
4. “online video”;
5. “Available from”;
6. URL where the video is hosted;
7. “Accessed”;
8. Date the video was watched.

Examples:

E11. Podcast

Reference syntax:
1. Organisation;
2. Year in which it was made;
3. Name of podcast (SCC, in italics);
4. Publisher;
5. Date of podcast;
6. “podcast”;
7. “Available from”;
8. URL where the podcast is available;
10. Date that the podcast was accessed.

Examples:

E12. Online illustration

Reference syntax:
1. Family name of author;
2. Initials of Author;
3. Year the image was produced;
4. Title of the image or a description (SCC, in italics);
5. Format and any details;
6. Name and place of the sponsor of the source;
7. “Available from”;
8. URL where the image is hosted;
10. Date when the image was viewed.

Example:


Notes
• An author of a website includes an individual, group of individuals, company, organisation, department and institution etc.
• If a website does not state when it was created or last updated then the abbreviation n.d. (no date) can be substituted for the year of publication.
• If you have cross-checked and verified the source is reliable but there is no obvious author then use the title of the document or webpage in place of the author followed by the year and other publication details as per the required syntax.
• Generally only the Uniform Resource Locator (URL) for the site home page of the reference source needs to be included. If the page URL of the information being cited is reasonably short, that is less than one line, then the full URL may be included.

adapted from Appendix 3 in Guide to Author (AusIMM, 2011), Style Guide (Snooks and Co., 2002) and Harvard Referencing for Electronic Sources (UNSW, 2010).
Appendix 2

An example of a technical report

This Appendix contains an example of a technical report that reflects the standards outlined in the MEA Report Writing Guide.

Note: this is an amended copy of the report with extracts that have been altered to illustrate the various elements of Structure, Format and Style in a report.
SUMMARY

The results and conclusions of this research project are based on experiments undertaken using a laboratory-scale, single shear rock re-enforcement test facility that was designed, constructed and commissioned in the School of Mining Engineering at the University of New South Wales (UNSW).

The test facility was developed to improve understanding of the behaviour of rock reinforcement elements when subjected to shear in order to better manage shear loading conditions and thereby contribute to better design and application of these elements in underground mine environments. To this end the project examined the effect of a number of parameters on the performance of reinforcement elements.

The results indicate the rock environment behaves as a system as the interaction between the various reinforcement elements was markedly different to the observed behaviour of individual elements when tested in isolation.
CONTENTS

SUMMARY .............................................................................................................................................. i

1. INTRODUCTION ................................................................................................................................. 1

1.1 RESEARCH OBJECTIVES ............................................................................................................. 1

1.1.1 Ground anchors ....................................................................................................................... 1

2. CONCRETE CASTING ....................................................................................................................... 3

2.1 INTRODUCTION ............................................................................................................................. 3

2.2 CONCRETE ...................................................................................................................................... 3

3. PROPERTIES OF TEST MATERIALS .............................................................................................. 4

4. TEST RESULTS ................................................................................................................................. 5

5. CONCLUSIONS ................................................................................................................................. 7

6. RECOMMENDATIONS ...................................................................................................................... 8

7. REFERENCES ..................................................................................................................................... 9

APPENDIX
1 INTRODUCTION

Rock support has evolved within the mining, tunnelling and civil industries particularly with the use of rockbolts as the primary means to support the rockmass (Gerdeen et al., 1977). New applications and innovations of rock reinforcement have continued to appear on the market and are regularly trialled and used in Australia and the rest of the world. Within Australian underground coal mines, rockbolts are most often used as a reinforcing element in primary roof and rib support.

A typical Australian underground coal longwall mine producing around 3 Mtpa uses between 4000 and 6000 rockbolts per month, which equates to a total cost of approximately A$150 000 per month for rockbolts, plates, resin and accessories (Gardner, 1998a).

A research project based on experiments using a laboratory-scale, single shear rock reinforcement test facility was undertaken in the School of Mining Engineering.

1.1 RESEARCH OBJECTIVES

The objectives of the research project were to:

- define current understanding of reinforcement elements when subjected to shear;
- design and develop an appropriate test facility; and
- conduct a series of controlled laboratory experiments to study the effects of:
  - the geomechanical properties of rock;
  - element pre-tensioning; and
  - applied loading rate
  on the performance of reinforcement elements in both direct shear resistance and indirect shear resistance with axial clamping.

1.1.1 Ground anchors

Ground anchors are more often used in civil engineering than in mining. They are used to transmit a tensile load to a load bearing stratum. A ground anchor such as that shown in...
Figure 1 typically consists of three components these being an anchor head, free anchor length and fixed anchor. Ground anchors are generally 15 m or more in length. They tend to have a large cross-sectional area so as to provide sufficient load capacity necessary to support the often substantial mass of unstable material. Ground anchors can be grouped into two broad categories based on their primary modes of action either high axial capacity elements or high shear capacity elements (C Windsor & R Thompson 1999).

High axial capacity elements are in the majority with around 90% of all ground anchors. They include an array of long individual elements that are orientated for a stable reinforcing element and discretely coupled over a fairly long anchorage length at the far end (bond length). At the collar of this reinforcing element, the ground anchor is secured to the rock mass face using an external mechanical fixture (free length). The free length is....

While the section on ground anchors (§1.1.1) provides important background information on what a ground anchor is, how it functions and where it is used, the introduction should also present a problem statement so the objectives of the report are justified.

What is the problem with ground anchors that leads to the need for further research?

It is also a good idea to end the introduction with an outline of the report. Usually this is just a few sentences explaining how the report is organised.
2 CONCRETE CASTING

2.1 INTRODUCTION

The importance of the surrounding rockmass is critical in analysing the performance of a reinforcing element under a shear load. The test program used concrete to simulate the surrounding rockmass having similar levels of strength, static modulus of elasticity and Poisson’s ratio but equally important it is a homogeneous material and an unlimited number of samples can be provided.

2.2 CONCRETE

The ability for cement to flow when mixed with aggregate and water makes it ideal for casting before hardening to form a stone-like material.

The test procedure used only fully cured concrete to ensure consistency in the material properties; these included measurement of compressive strength, static modulus of elasticity and Poisson’s ratio.

During casting of the concrete into the steel formwork, we prepared concrete test cylindrical specimens having dimensions of 100 mm diameter by 200 mm high as shown in Figure 2 to determine the properties of the concrete.

Figure 2 Concrete cylindrical specimens prior to testing.
3 PROPERTIES OF TEST MATERIALS

The Static Modulus of Elasticity \((E)\) and Poisson’s Ratio \((\nu)\) were determined in accordance with ATSM C469. The Standard specifies Young’s Modulus and Poisson’s Ratio of Portland cement concrete be determined under longitudinal loading conditions using the chord modulus to define elasticity. For normal weight concrete, \(E\) ranges between 14 and 41 GPa.

The Static Modulus of Elasticity can be calculated using Equation 1.

\[
E = \frac{\sigma_2 - \sigma_1}{\varepsilon_2 - 0.00005}
\]

where:

- \(E\): chord modulus of elasticity
- \(\sigma_1\): stress corresponding to a longitudinal strain
- \(\sigma_2\): stress corresponding to 40% of the estimated ultimate load
- \(\varepsilon_2\): longitudinal strain corresponding to the \(\sigma_2\) stress

Results of the concrete cylinder compression test are summarised in Table 1.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>(P_1)</th>
<th>(P_2)</th>
<th>(P_3)</th>
<th>(P_4)</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core diameter (mm)</td>
<td>100.2</td>
<td>100.2</td>
<td>100.3</td>
<td>100.1</td>
<td>100.2</td>
</tr>
<tr>
<td>Maximum load (Kn)</td>
<td>514.9</td>
<td>561.6</td>
<td>495.7</td>
<td>489.9</td>
<td>518.7</td>
</tr>
<tr>
<td>Strength (mpa)</td>
<td>65.3</td>
<td>71.2</td>
<td>62.8</td>
<td>62.3</td>
<td>65.9</td>
</tr>
</tbody>
</table>

The strength of the concrete exceeded 60 MPa with an average strength of 65.9 MPa…
4 TEST RESULTS

Figure 3 shows the variation in stress with ram displacement of sample $P_1$ during testing using a Schenk Test Machine. The graph indicates a constant stiffness up to the point of failure and significant residual strength in the post-failure region.

![Graph showing stress vs. displacement](image)

**Figure 3.** Loading characteristic for test sample $P_1$.

A hydraulic load cell was placed between two steel plates located between the concrete surface (borehole collar) and the dome plate as shown in Figure 4.

![Diagram of load cell arrangement](image)

**Figure 4.** Schematic of load cell arrangement used to determine the level of pre-tension in a rockbolt.

A number of issues arose during installation of Samples 4 and 6. These issues are summarised in Table 2.
Table 2.  
Summary of the issues in setting test samples.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Hole Length</th>
<th>Installation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1125 mm</td>
<td>Spin time: 20 s Hold: 60 s Pre-tension required: 40 kN</td>
<td>Borehole was too long after the steel plates and load cells were introduced to the system. The length of the hole was too long to allow the rockbolt to secure itself to the system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>It is not a sign of weakness to discuss problems or failures. Rather it is an opportunity to show what has been learned from these setbacks and it can help justify your final choices or decisions. Including ‘what not to do’ or ‘what does not work’ also serves to inform your peers, so they can avoid similar problems in the future.</td>
</tr>
<tr>
<td>6</td>
<td>1060 mm</td>
<td>Spin time: 20 s Hold: 60 s Pre-tension required: 45 kN Pre-tension attained: 55 kN</td>
<td>Two fast-set resin capsules were inserted into the borehole in order to gain an applied pre-tension. The resin nut broke out quickly once the rockbolt made contact with the end of the borehole</td>
</tr>
</tbody>
</table>

The rockbolt was subjected to a combination of both shear and axial loading that led to the formation of two plastic hinges coinciding with the points of maximum bending stress. Due to the strength of the concrete, the rockbolt crushed the concrete around the borehole wall as shown in Figure 5.

![Figure 5. Extent of bending of the tendon and associated crushing around the borehole.](image-url)
5 CONCLUSIONS

The objective of this project was to investigate the behaviour of rockbolts when subjected to shear. A full-scale laboratory shear testing facility was designed, constructed and commissioned to model the action of shear forces on a rock reinforcing element as occurs in an underground environment.

As a result of the test program, the following conclusions can be made.

- The shear resistance of a rockbolt when installed in concrete was found to be more than double the shear strength and greater than the ultimate tensile strength of the rockbolt steel. The enhanced performance is thought to be due to a combination of the friction induced between the shear surfaces and confinement offered by the borehole.

- There were two distinct loading regimes observed between applied shear load and shear displacement. Initially the system reflected a large stiffness after which the stiffness reduced with continued displacement and yield of the rockbolt until eventual failure.

- The level of stiffness varied with the loading rate with higher levels of stiffness attained at higher loading rates.
6 RECOMMENDATIONS

Based on the results of this study it is recommended that further investigation be undertaken with respect to:

- borehole and element geometry;
- element orientation relative to discontinuity; and
- element and encapsulation material properties.
7 REFERENCES


BSI—see British Standards Institute


Appendix 3

An example of a conference paper

Section A: This section contains an example of a conference paper (amended and with annotations) indicating various styles used in preparing the document and various editing notes. The style sheet, StyleTemplate_MEA_ConferencePaper doc, was used to prepare the document which is available for download from the Learning Management System.

Section B: This section contains the edited version of the conference paper without annotations.

This paper was first published in Technology Roadmap for Rock Mechanics, Proceedings 10th Congress of the International Society for Rock Mechanics, 2003, (South African Institute of Mining and Metallurgy)
Section A

The effect of resin annulus on anchorage performance of fully encapsulated rockbolts

Patrick Hanrahan
The University of New South Wales (UNSW), Sydney

INTRODUCTION

Rockbolts are increasingly relied on as a key component in the primary support mechanism of many underground mines. In the Australian coal mining industry, for example, over 5 million rockbolts are installed each year at a cost of over A$35 million. Previous research by UNSW, Strata Control Technology Pty Ltd (SCT) and Powercoal Ltd has found that over 30% of rockbolts 'are not providing optimum performance in coal mining environments' (Galvin et al. 2001).

A research initiative has been launched combining the skills and experience of industry and research expertise in the university to develop an understanding of fully encapsulated rockbolts. The broad objective being to improve the performance of rockbolt systems and hence improve the overall safety in mines. This initiative resulted in the establishment of a test facility at UNSW that operates within a controlled laboratory environment.

TEST FACILITY

Design objectives

The desirable attributes of a rockbolt test facility were seen as:

- the facility should be capable of examining a wide range of parameters associated with the installation of rockbolts and of replicating a wide range of conditions;
- tests should be carried out under controlled conditions to better ensure the repeatability of results; and
- the facility should be available for use by industry (both suppliers of rockbolt systems and industry end-users) for such purposes as independently assessing the performance of new products or changes in the method of installation.

The design of the test facility incorporates a hydraulic ram similar to that used in most rockbolt pull-out tests. The ram can apply various load conditions to a rockbolt. A bi-axial cell is used to hold the test specimen containing a fully encapsulated rockbolt. The test specimen may either be a sample of rock replicating the conditions in a particular mine or a man-made material. The advantage of the latter is it mitigates many of the problems that can arise due to the variability in material properties between rock samples.

Facility features

The test facility at the UNSW Mining Research Centre uses a modified workshop lathe as the test platform. The main components of the facility are:

- a bi-axial cell with an internal length of 200 mm and confinement pressure of 30 MPa between the cell and the bed of the lathe;
- servo-control hydraulic system used for precise control of the loading rate of a 300 kN capacity hollow core ram during a pull-out test;
**TEST SAMPLE PREPARATION**

**Test samples**

| Type | A cementitous grout (Celtite MG75S) was selected in place of cored rock samples in the test program. The grout strength was approximately 75 MPa. |

**Preparation**

In order to ensure uniform material properties, a single batch of over 100 test samples was prepared and cast in plastic moulds. Each core of 145 mm and length of 200 mm.

**Rockbolt anchorage**

A Celtite 24 mm extra high strength used in the test program. The rockbolt core diameter of 21.7 mm, a diameter of 22.8 mm and rib spacing of 10 mm has an ultimate tensile strength of 344 kN.

A mix-and-pour resin was subsequently used in the test program. After mixing, the resin was injected into the hole into which the spinning rockbolt was rammed. The rockbolt was supported in the chuck while the resin was left to set for 10 min. The resin was then allowed to cure for a further 48 h with the rockbolt and sample standing vertically.

**EXPERIMENTAL PROGRAM**

**Procedure**

In summary, the test procedure involved a load being applied between the rockbolt and end surface of the test sample as illustrated in Figure 1. This tensile load is intended to simulate the induced load on a rockbolt when separation occurs between partings in rock strata.

During each test, the outer surface of the test sample was subjected to a confinement of 10 MPa within the bi-axial cell. Before a pullout test began, a valve was closed to stop the flow of hydraulic fluid to the cell. The level of confinement simulates *in situ* field conditions but it was also the minimum level necessary to support the sample in the cell during drilling and pullout test. A pressure transducer monitored any pressure change in the bi-axial cell during each test.

**Table 1**

<table>
<thead>
<tr>
<th>Annulus thickness (mm)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of elastic behaviour – load (kN)</td>
<td>180</td>
<td>180</td>
<td>190</td>
<td>60</td>
</tr>
<tr>
<td>Stiffness within elastic region (kN/mm)</td>
<td>99.4</td>
<td>85.0</td>
<td>100</td>
<td>40.0</td>
</tr>
<tr>
<td>Maximum Pullout Load (MPL) (kN)</td>
<td>225</td>
<td>245</td>
<td>240</td>
<td>185</td>
</tr>
<tr>
<td>Residual load at 50 mm displacement (kN)</td>
<td>60</td>
<td>70</td>
<td>90</td>
<td>45</td>
</tr>
</tbody>
</table>
The effect of resin annulus on anchorage performance of fully encapsulated rockbolts

Unfortunately the current monitoring arrangement tended to even out any transient changes in stress that might occur along the length of the test sample. Alternate arrangements to monitor any induced stress changes are being considered in future experiments.

Analysis

Little difference was observed in the curves for resin annulus thickness of 2, 3, and 4 mm as indicated in the summary graph in Figure 5. The performance of the anchorage systems in these instances exhibited a relatively high as well as consistent level of stiffness up to the point of maximum pullout load (MPL); the latter being the maximum load bearing capacity of the anchorage system.

This initial elastic behaviour reflected the material properties of the rockbolt component in the anchor system as well as the cohesiveness between the rockbolt, resin and rock. As the MPL is less than the UTS of the rockbolt, the MPL is likely to indicate failure of either the resin/rock or resin/rockbolt interface or both.

Beyond the MPL, the resistance to the externally applied load fell away with further displacement of the rockbolt until a residual resistance level was reached for the anchorage system. It is interesting to note that this residual resistance still represented a reasonably high value equivalent to about 70% of the MPL.

Consequently even after failure of the resin interface, a fully encapsulated rockbolt can still provide an appreciable level of resistance against separation of rock strata.

It should be cautioned, however, that the level of this residual resistance might be dependent on the nature of material properties of the surrounding rock mass and further testing would be required to confirm this.

CONCLUSION

The test program indicated that there was an optimum range of resin annulus thickness within which there was little change in the performance of a fully encapsulated rockbolt anchorage system.

Either side of this optimum range there was a reduction in the MPL as well as other properties of the anchorage system. For example, it was found that for the case of a 21.7 mm rockbolt used in the test program when resin annulus reached 5 mm in a 32 mm diameter hole, there was a reduction of nearly 25% in MPL from that achieved within the optimum annulus range. This can significantly degrade the capability of the rockbolt to bind together rock strata.

It is yet to be demonstrated whether the optimum range of resin annulus and hence allowable tolerance of the hole diameter varies with the diameter of a rockbolt.

The test program also indicated that a fully encapsulated rockbolt anchorage system can still provide a reasonable level of resistance to the separation or relative displacement between strata when the maximum load bearing capacity of the system has been exceeded.

The findings are in general agreement with recommendations by suppliers of rockbolt systems. Findings impress the importance of matching the rockbolt diameter with the hole size for a given rockbolt system.

ACKNOWLEDGEMENTS

The author acknowledges support by the Australian Coal Association Research Program (ACARP) for funding the research project. The project was also assisted by Celtite Pty Ltd which provided test materials. The author wishes to thank Dr M Smith for supervising the project and the contributions made by John Steel and Daniel Lin to the project.

REFERENCES

[Note: Only references cited in the Conference Paper should be listed in the References. Do NOT include all references from thesis or original report.

References are cited to the standards stated in AusIMM Guide to Authors (2011)]
The effect of resin annulus on anchorage performance of fully encapsulated rockbolts

Patrick Hanrahan
The University of New South Wales (UNSW), Sydney

A diverse selection of rockbolt designs and resin anchors are available for use in underground mines. Research in recent years at the UNSW Mining Research Centre led to the construction of a rockbolt pull-testing facility. This facility has subsequently been upgraded, commissioned and initial test work has been completed to verify the pull-test process.

A test program has been completed with the objective to understand the load transfer mechanism and improve the general performance of rockbolts. This paper describes the results of this research.

INTRODUCTION

Rockbolts are increasingly relied on as a key component in the primary support mechanism of many underground mines. In the Australian coal mining industry, for example, over 5 million rockbolts are installed each year at a cost of over A$35 million. Previous research by UNSW, Strata Control Technology Pty Ltd (SCT) and Powercoal Ltd has found that over 30% of rockbolts ‘are not providing optimum performance in coal mining environments’ (Galvin et al. 2001).

A research initiative has been launched combining the skills and experience of industry and research expertise in the university to develop an understanding of fully encapsulated rockbolts. The broad objective being to improve the performance of rockbolt systems and hence improve the overall safety in mines. This initiative resulted in the establishment of a test facility at UNSW that operates within a controlled laboratory environment.

TEST FACILITY

Design objectives

The desirable attributes of a rockbolt test facility were seen as:

- the facility should be capable of examining a wide range of parameters associated with the installation of rockbolts and of replicating a wide range of conditions;
- tests should be carried out under controlled conditions to better ensure the repeatability of results; and
- the facility should be available for use by industry (both suppliers of rockbolt systems and industry end-users) for such purposes as independently assessing the performance of new products or changes in the method of installation.

The design of the new test facility incorporates a hydraulic ram similar to that used in most rockbolt pull-out tests. The ram can apply various load conditions to a rockbolt. A bi-axial cell is used to hold the test specimen containing a fully encapsulated rockbolt. The test specimen may either be a sample of rock replicating the conditions in a particular mine or, a man-made material. The advantage of the latter is it mitigates many of the problems that can arise due to the variability in material properties between rock samples.

Facility features

The test facility at the UNSW Mining Research Centre uses a modified workshop lathe as the test platform. The main components of the facility include:

- a bi-axial cell with an internal diameter of 145 mm, length of 200 mm and rated maximum confinement pressure of 30 MPa mounted to the bed of the lathe;
- servo-control hydraulic system used for precise control of the loading rate of a 300 kN capacity hollow core ram during a pull-out test;
TEST SAMPLE PREPARATION

Test samples

Type

A cementitious grout (Celtite MG75S) was selected in place of cored rock samples in the test program. The grout strength was approximately 75 MPa.

Preparation

In order to ensure uniform material properties, a single batch of over 100 test samples was prepared and cast in plastic moulds. Each core had a diameter of 145 mm and length of 200 mm.

Rockbolt anchorage

A Celtite 24 mm extra high strength CX rockbolt was used in the test program with a basic profile design. The rockbolt has an inner core diameter of 21.7 mm, a diameter across the ribs of 22.8 mm and rib spacing of 10 mm. The rockbolt has an ultimate tensile strength of 344 kN.

A mix-and-pour resin was subsequently used in the test program. After mixing, the resin was injected into the hole into which the spinning rockbolt was rammed. The rockbolt was supported in the chuck while the resin was allowed to set for 10 min. The resin was then left to cure for a further 48 h with the rockbolt and sample standing vertically.

EXPERIMENTAL PROGRAM

Procedure

In summary, the test procedure involved a load being applied between the rockbolt and end surface of the test sample as illustrated in Figure 1. This tensile load is intended to simulate the induced load on a rockbolt when separation occurs between partings in rock strata.

During each test, the outer surface of the test sample was subjected to a confinement of 10 MPa within the bi-axial cell. Before a pullout test began, a valve was closed to stop the flow of hydraulic fluid to the cell. The level of confinement simulates in situ field conditions but it was also the minimum level necessary to support the sample in the cell during drilling and pullout test. A pressure transducer monitored any pressure change in the bi-axial cell during each test.

Observations

Reasonable repeatability was observed for each level of resin annulus as illustrated in Figure 2. This figure shows the load/displacement curve for the 3 mm annulus test.

Figure 1. Test set-up showing the arrangement of the bi-axial cell, hydraulic ram, pressure transducer and LVDT.

Figure 2. Load/displacement curve for an anchorage system with a 3 mm annulus (after Hagan and Weckert, 2002).

The results from the test program are summarised in Table 1. There was little measurable change observed in the pressure of the bi-axial cell during each test. The experimental noise tended to mask any changes that might have otherwise occurred.

Table 1

<table>
<thead>
<tr>
<th>Annulus thickness (mm)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of elastic behaviour – load (kN)</td>
<td>180</td>
<td>180</td>
<td>190</td>
<td>60</td>
</tr>
<tr>
<td>Stiffness within elastic region (kN/mm)</td>
<td>99.4</td>
<td>85.0</td>
<td>100</td>
<td>40.0</td>
</tr>
<tr>
<td>Maximum Pullout Load (MPL) (kN)</td>
<td>225</td>
<td>245</td>
<td>240</td>
<td>185</td>
</tr>
<tr>
<td>Residual load at 50 mm displacement (kN)</td>
<td>60</td>
<td>70</td>
<td>90</td>
<td>45</td>
</tr>
</tbody>
</table>

Unfortunately the current monitoring arrangement tended to even out any transient changes in stress that
might occur along the length of the test sample. Alternate arrangements to monitor any induced stress changes are being considered in future experiments.

**Analysis**

Little difference was observed in the curves for resin annulus thicknesses of 2, 3 and 4 mm as indicated in the summary graph in Figure 5. The performance of the anchorage systems in these instances exhibited a relatively high as well as consistent level of stiffness up to the point of maximum pullout load (MPL); the latter being the maximum load bearing capacity of the anchorage system.

This initial elastic behaviour reflected the material properties of the rockbolt component in the anchor system as well as the cohesiveness between the rockbolt, resin and rock. As the MPL is less than the UTS of the rockbolt, the MPL is likely to indicate failure of either the resin/rock or resin/rockbolt interface or both.

Beyond the MPL, the resistance to the externally applied load fell away with further displacement of the rockbolt until a residual resistance level was reached for the anchorage system. It is interesting to note that this residual resistance still represented a reasonably high value equivalent to about 70% of the MPL.

Consequently even after failure of the resin interface, a fully encapsulated rockbolt can still provide an appreciable level of resistance against separation of rock strata.

It should be cautioned, however, that the level of this residual resistance might be dependent on the nature of material properties of the surrounding rock mass and further testing would be required to confirm this.

**CONCLUSION**

The test program indicated that there was an optimum range of resin annulus thickness within which there was little change in the performance of a fully encapsulated rockbolt anchorage system.

Either side of this optimum range there was a reduction in the MPL as well as other properties of the anchorage system. For example, it was found that for the case of a 21.7 mm rockbolt used in the test program when resin annulus reached 5 mm in a 32 mm diameter hole, there was a reduction of nearly 25% in MPL from that achieved within the optimum annulus range. This can significantly degrade the capability of the rockbolt to bind together rock strata.

It is yet to be demonstrated whether the optimum range of resin annulus and hence allowable tolerance of the hole diameter varies with the diameter of a rockbolt.

The test program also indicated that a fully encapsulated rockbolt anchorage system can still provide a reasonable level of resistance to the separation or relative displacement between strata even when the maximum load bearing capacity of the anchorage system has been exceeded.

These findings are in general agreement with recommendations by suppliers of rockbolt systems. The findings impress the importance of matching the correct hole size for a given rockbolt diameter.

**ACKNOWLEDGEMENTS**

The author acknowledges support by the Australian Coal Association Research Program (ACARP) for funding the research project. The project was also assisted by Celtite Pty Ltd which provided test materials. The author wishes to thank Dr M Smith for supervising the project and the contributions made by John Steel and Daniel Lin to the project.

**REFERENCES**


Appendix 4

Examples of spelling and hyphenation of some mining related technical terms
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ball mill</td>
<td>on-site</td>
</tr>
<tr>
<td>bypass</td>
<td>open cut</td>
</tr>
<tr>
<td>cost-effective</td>
<td>ore dressing</td>
</tr>
<tr>
<td>cross-cut</td>
<td>ore shoot</td>
</tr>
<tr>
<td>cross-section</td>
<td>orebody</td>
</tr>
<tr>
<td>cut-off</td>
<td>orepass</td>
</tr>
<tr>
<td>drill core</td>
<td>outcrop</td>
</tr>
<tr>
<td>drill hole</td>
<td>overall</td>
</tr>
<tr>
<td>flocculent</td>
<td>overflocculated</td>
</tr>
<tr>
<td>fly-in, fly-out</td>
<td>pre-existing</td>
</tr>
<tr>
<td>hanging wall</td>
<td>program</td>
</tr>
<tr>
<td>headframe</td>
<td>reagent</td>
</tr>
<tr>
<td>impeller</td>
<td>recleaning</td>
</tr>
<tr>
<td>in situ</td>
<td>regrind</td>
</tr>
<tr>
<td>in-depth</td>
<td>rock-crushing plant</td>
</tr>
<tr>
<td>interlevel</td>
<td>screen sizing test</td>
</tr>
<tr>
<td>iron ore deposit</td>
<td>self-actuated</td>
</tr>
<tr>
<td>jackhammer</td>
<td>short-term</td>
</tr>
<tr>
<td>jaw crusher</td>
<td>sink-float system</td>
</tr>
<tr>
<td>lead-zinc ore</td>
<td>solid-liquid interface</td>
</tr>
<tr>
<td>liquid-solid separation</td>
<td>start-up</td>
</tr>
<tr>
<td>long-term</td>
<td>sublevel</td>
</tr>
<tr>
<td>low-grade</td>
<td>sulfide</td>
</tr>
<tr>
<td>mine site</td>
<td>sulfur (also related terms)</td>
</tr>
<tr>
<td>multilevel</td>
<td>test work</td>
</tr>
<tr>
<td>non-metallic</td>
<td>time frame</td>
</tr>
<tr>
<td>off-line</td>
<td>trialled</td>
</tr>
<tr>
<td>offshore</td>
<td>two-thirds</td>
</tr>
<tr>
<td>off-site</td>
<td>world-class</td>
</tr>
<tr>
<td>one-half</td>
<td>worldwide</td>
</tr>
<tr>
<td>one-twentieth</td>
<td>ongoing</td>
</tr>
</tbody>
</table>

adapted from Appendix 1 in AusIMM (2011)
Appendix 5

Abbreviations used in report writing
°  degree (angle)
°C  degree (Celcius)
A   ampere
A$  Australian dollar
ac  alternating current
ACF Australian Conservation Foundation
AGC Australian Geoscience Council
AGSO Australian Government Survey Organisation (formerly BMR)
AGPS Australian Government Publishing Service
Ah  ampere hour
AIG Australian Institute of Geoscientists
AIME American Institute of Mining, Metallurgical and Petroleum Engineers
alk alkaline
am  antimeridian (before noon)
AMEC Australian Mining Exploration Companies
AMF Australian Mineral Foundation
AMIRA Australian Mineral Industry Research Association International
and not abbreviated (do not use “&”)
aq  aqueous
AR  Analytical standard of purity
AS  Australian Standard (usually with number and date, eg AS373S-I990)
at  atomic
at wt atomic weight
atm atmosphere/atmospheric
ATS Australian Academy of Technological Sciences and Engineering
av  average
bbi  US petroleum barrel
BHN Brinell Hardness Number
BS  British Standard
BSS British Standard Specification
cal calorie
calc calculated
cf  compare
CIM Canadian Institute of Mining Metallurgy and Petroleum
cm  centimetre
cm/s centimetre per second
cm² square centimetre
cm³ cubic centimetre
cm³/s cubic centimetre per second
CMMI Council of Mining and Metallurgical Institutions
coeff coefficient
const constant
cos cosine
cot cotangent
crit critical
cryst crystallised
CSIRO Commonwealth Scientific and Industrial Research Organisation
CV calorific value
d  day
db  decible
ρ  density
dc  direct current
Dept department
dia diameter
dil  dilute
E  east
ed(s) editor(s)
edn edition
η  efficiency
eg  for example
EPA Environment Protection Agency
eqn equation
equiv equivalent
equiv wt equivalent weight
ESD ecologically sustainable development
etc etcetera
eV  electron volt
expt experiment(-al)
pH  measure of acidity or alkalinity
pm  postmeridian (after noon)
ppb parts per billion
ppm parts per million
qual qualitative
quan quantitative
rad radian/radius
rev revolution
rev/min revolutions per minute
s second (time)
S south
SD standard deviation
SE south east
ser series
SI International System Units
sic incorrectly written in the original
sin sine
SME Society of Mining, Metallurgy and Exploration Inc
soln solution
sq square
SSW south south west
tonne
t/d tonne per day
t/h tonne per hour
t/m tonne per month
tan tangent
temp temperature
TMS The Minerals, Metals and Materials Society
US$ US dollars
V volt
var variety
vel velocity
η viscosity
vol(s) volumes(s)
vs versus
W Watt
W west
w/v weight for volume
w/w weight for weight
Wh watt hour
wk week
WNW west north west
wt per cent weight per cent
wt weight
yr year

adapted from Appendix 2 in AusIMM (2011)
Appendix 6

A checklist for report writing
### FORMAT

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>heading and subheadings</td>
<td>laid out logically and consistently at each level (size and style of headings)</td>
<td>pp14-15</td>
</tr>
<tr>
<td>decimal and numbering system of sections</td>
<td>used accurately and consistently; in most cases no more than three levels of heading is necessary in most reports</td>
<td>p 14</td>
</tr>
<tr>
<td>page numbers</td>
<td>place in top right hand corner</td>
<td>p 15</td>
</tr>
<tr>
<td>headers and footers</td>
<td>it most instances they are unnecessary so avoid using</td>
<td>p 15</td>
</tr>
<tr>
<td>physical presentation, legibility, layout</td>
<td>include title page; stapling suitable for short reports but for longer use more heavy duty forms such as comb binding or perfect binding do not use place separate pages in individual plastic sleeves</td>
<td></td>
</tr>
</tbody>
</table>

### TABLES AND FIGURES

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>key tables/figures</td>
<td>placed in main body of report: each table and figure must be labelled and referred to in the text of report</td>
<td>pp 17-20</td>
</tr>
<tr>
<td>significant figures</td>
<td>round values to appropriate number of significant figures to reflect accuracy of value - generally three figures will suffice; use scaling factors for units and/or scientific notation</td>
<td>p 16</td>
</tr>
<tr>
<td>captions for tables and figures</td>
<td>concise but self-explanatory; captions for tables placed above the table; captions for figures below the figure</td>
<td>p 20</td>
</tr>
<tr>
<td>caption information</td>
<td>concise summary that complements the information stated in the text</td>
<td>p 20</td>
</tr>
<tr>
<td>data in tables and figures</td>
<td>consistent (cross-checks) with the data in text</td>
<td>p 18</td>
</tr>
<tr>
<td>symbols, labels and signs notation/asterisks</td>
<td>explanatory notes provide further information immediately below table/figure</td>
<td>p 17-19</td>
</tr>
<tr>
<td>reference citation</td>
<td>if table or figure not your own then cite source</td>
<td>p 20</td>
</tr>
</tbody>
</table>

### STRUCTURE

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>names/titles of people etc summary</td>
<td>spelt correctly and appropriately acknowledged written to highlight and summarise significant information; usually less than 250 words and address three dimensions - what is the objective of study/purpose of report, what you did and, what you found/conclude/recommend</td>
<td>p 8</td>
</tr>
<tr>
<td>table of contents</td>
<td>clear and simple structure on page; matches exactly the headings in the report; include section numbers cross referenced to page number in report</td>
<td>p 9</td>
</tr>
<tr>
<td>page numbering</td>
<td>on preliminary pages use Roman numerals up to and including contents pages; restart page numbering using Arabic numerals from the introduction section</td>
<td>p 15</td>
</tr>
<tr>
<td>definitions of new terms</td>
<td>expressed accurately and clearly</td>
<td></td>
</tr>
<tr>
<td>abbreviations and acronyms</td>
<td>written out fully when first used with abbreviations in round brackets</td>
<td>p 25</td>
</tr>
<tr>
<td>report self-contained appendices</td>
<td>includes all relevant information</td>
<td></td>
</tr>
<tr>
<td>appendices</td>
<td>each appendix referred to in main body of report; contains information to support findings; only contains relevant information; do not use to “bulk-up” report</td>
<td>p 12</td>
</tr>
</tbody>
</table>
### CONTENT

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>information content</td>
<td>depth and appropriateness; uses sufficient referenced material; author's opinions/key findings clearly stated; assumptions clearly stated especially if not all information was not known or accessible; information by other authors to support argument is clearly referenced</td>
</tr>
<tr>
<td>quality of discussions and conclusions</td>
<td>answers the question/problem/objective posed in the introduction – states how the objective of the study was fulfilled.</td>
</tr>
</tbody>
</table>

### REFERENCING

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>acknowledgement of all sources of information (other than your own) in figure captions, tables and whenever paraphrased or quoted in text</td>
<td>cite all reference sources using author/year system in main body of report</td>
</tr>
<tr>
<td>reference list</td>
<td>full bibliographical details provided for all reference sources; all references cited in report must be included in list; only references cite in report to be included in list; list of references sorted by author and year</td>
</tr>
<tr>
<td>reference components</td>
<td>all elements of reference provided (author, year, title of publication and publisher) and laid out in the preferred style</td>
</tr>
<tr>
<td>punctuation</td>
<td>follow exactly the standardised punctuation; be consistent; use of capitals and italics as required</td>
</tr>
</tbody>
</table>

### TECHNICAL

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>wordiness</td>
<td>ensure report has been adequately proofread and proofread; check spelling conforms to Australian standards; omit redundant or unnecessary words and phrases and, avoid obfuscation!; use plain and simple english; avoid “old world words and phrases such as appertaining to, herewith</td>
</tr>
<tr>
<td>avoid colloquialisms</td>
<td>avoid everyday informal language; for the message to appear impartial, to engage the reader and ensure wide acceptance of report findings it is better to adopt a formal writing style</td>
</tr>
<tr>
<td>sentences</td>
<td>complete, tight and varied in length; avoids long sentences</td>
</tr>
<tr>
<td>passive voice</td>
<td>used appropriately to emphasise the object of action rather than the agent; avoid first person, use third person appropriately,</td>
</tr>
<tr>
<td>parallel construction</td>
<td>applied accurately for lists of information</td>
</tr>
<tr>
<td>agreement</td>
<td>subjects and verbs are related in number and person, e.g. she does, they do, it does</td>
</tr>
<tr>
<td>other expression</td>
<td>gender inclusive language, grammar, punctuation, tenses, fluency, correct word choice, conciseness, avoids clichés</td>
</tr>
</tbody>
</table>

adapted from Winckel and Hart (1996)
# Index

<table>
<thead>
<tr>
<th>Abbreviations</th>
<th>Figures and tables 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract—see Structure</td>
<td>Hyperlinks 36</td>
</tr>
<tr>
<td>Citations—see Referencing</td>
<td>Interview 38</td>
</tr>
<tr>
<td>Contents—see Structure</td>
<td>Lecture, seminar, presentation 39</td>
</tr>
<tr>
<td>Dimensions, units—see Units of measurement</td>
<td>Legislation 39</td>
</tr>
<tr>
<td>Equations—see Numbering</td>
<td>List 11, 36</td>
</tr>
<tr>
<td>Executive summary—see Structure</td>
<td>Long names 38</td>
</tr>
<tr>
<td>Figures 18</td>
<td>Multiple authors 35, 37</td>
</tr>
<tr>
<td>Figure captions 20</td>
<td>Multiple publications 37</td>
</tr>
<tr>
<td>Reference source 21</td>
<td>Multiple sources 37</td>
</tr>
<tr>
<td>Format 13</td>
<td>Primary reference 36</td>
</tr>
<tr>
<td>Bold 14</td>
<td>Publication details 35</td>
</tr>
<tr>
<td>Capitals 14, 21</td>
<td>Secondary reference 36</td>
</tr>
<tr>
<td>Font 13</td>
<td>Single author 35</td>
</tr>
<tr>
<td>Italics 14</td>
<td>Unknown publication date 40</td>
</tr>
<tr>
<td>Line spacing 13</td>
<td>Website 38</td>
</tr>
<tr>
<td>Margins 13</td>
<td>Section numbering—see Numbering</td>
</tr>
<tr>
<td>Underlining 14</td>
<td>Section Headings 15</td>
</tr>
<tr>
<td>Headers and footers—see Page headers and footers</td>
<td>Numbering—see Numbering</td>
</tr>
<tr>
<td>Headings—see Section headings</td>
<td>Significant figures 17</td>
</tr>
<tr>
<td>Illustration—see Figures</td>
<td>Spelling of mining terms 71-72</td>
</tr>
<tr>
<td>Margins—see Format</td>
<td>Structure 7</td>
</tr>
<tr>
<td>Non-breaking space 16, 21</td>
<td>Appendices 12</td>
</tr>
<tr>
<td>Numbering 18</td>
<td>Conclusions 11</td>
</tr>
<tr>
<td>Equations 18</td>
<td>Contents 9</td>
</tr>
<tr>
<td>Pages 15</td>
<td>Introduction 10</td>
</tr>
<tr>
<td>Sections 15</td>
<td>References 11</td>
</tr>
<tr>
<td>Page headers and footers 15</td>
<td>Summary 8</td>
</tr>
<tr>
<td>Page numbering—see Numbering 19</td>
<td>Title page 7</td>
</tr>
<tr>
<td>Plagiarism 31-32</td>
<td>Style 23</td>
</tr>
<tr>
<td>Referencing 31, 43-50</td>
<td>Tables 19</td>
</tr>
<tr>
<td>Author-date system 35</td>
<td>Table captions 21</td>
</tr>
<tr>
<td>CD/DVD-ROM, USB 39</td>
<td>Tables of contents—see Structure</td>
</tr>
<tr>
<td>Discussions 38</td>
<td>Units of measurement 15</td>
</tr>
<tr>
<td>Electronic sources 38-39</td>
<td>Values and numbering conventions 16</td>
</tr>
<tr>
<td>Spelling of mining terms 71-72</td>
<td>Writing style—see Style</td>
</tr>
</tbody>
</table>
Report Writing Guide for Mining Engineers

QUICK GUIDE TO REFERENCING

All sources of information or any material used in a report that is not your own original work must be acknowledged in the report. This includes text whether it is a direct quotation or paraphrased and whether it is used in whole or part as well as any other material such as a table of information or some form of illustration. The referencing system has two parts with the author(s) and year of publication cited in the body of the report next to where the material is used. In the text citation links to the full publication details contained in the References section of the report.

The type of information that needs to be provided for a hardcopy reference source includes:
- Editor’s surname
- Author surname
- Author initials
- Year published
- Conference title
- Journal title
- Title of contact
- Title
- The pages used
- The Publisher
- Published or not
- Conference title
- Online book info
- Source type
- Page URL
- Company name
- Author surname
- Author initials
- Year last updated
- Conference title
- Journal title
- Name of page
- Date accessed
- The pages used

Examples of referencing popular information sources

**Book**

**Information from a website**

**Article or paper on a website**

**Personal communication**
Clark, I. 2011. Personal communication, 10 November. Superintendent - Technical Services, ABC Mine, Bluevale Mining Ltd.

**Thesis**

**Online image used as figure**

**Electronic book**

**A paper in conference proceeding**
### Examples of referencing popular information sources

<table>
<thead>
<tr>
<th>Source Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecture/presentation note</strong></td>
<td>Laurence, D, 2008. Challenges and opportunities for sustainable mining practices in the Asia-Pacific Region. 11th Kenneth Finlay Memorial Lecture delivered at Law Library, University of New South Wales, 23 October.</td>
</tr>
<tr>
<td><strong>Withnall, I W, 1976b. Mines and mineral deposits in the Forsayth area, Queensland, Geol Surv Qld Rpt 91.</strong></td>
<td></td>
</tr>
</tbody>
</table>

### For more information on referencing refer to Chapter 7 in the Report Writing Guide for Mining Engineers

### Notes:

1. Generally only the Uniform Resource Locator (URL) for the site home page of the reference source needs to be included. If the page URL of the information being cited is reasonably short, that is less than one line, then the full URL may be included.
2. An author of a website can include an individual, a group of individuals, a company, an organisation, a department, an institution etc.
3. If a website does not state when it was created or last updated then the abbreviation n.d. (no date) can be substituted for the year of publication.
4. If there is no obvious author for the reference source then use the title of the document or webpage in place of the author followed by the year and other publication details as per the standard syntax.
Report Writing Guide
for Mining Engineers