Research Methodology

*SCENE, IIT Mandi*

# Elements of Technical Report Writing


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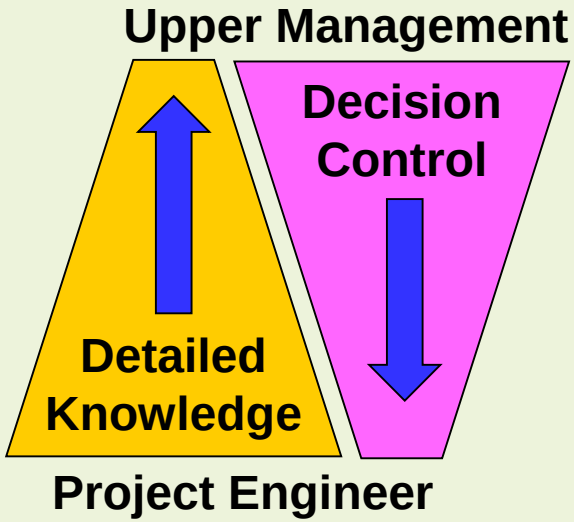
# Associated Lesson Concept

- Engineers spend a great deal of time writing **Technical Reports**
  - ❖ Academic sector
    - To explain project information to various audiences
    - To communicate pertinent information to make intelligent decisions
    - To record observations and inferences for future researches
  - ❖ Industry and Corporate sectors
    - Serves as a mode of effective and concise communication between the Project Engineers and Upper Management, and vice-versa



# Importance of Technical Writing

- Significant amount spent in technical writing
  - ❖ May consume even 1/3rd to ½ of the project duration or work time
    - Depends on the quantum of documentable resource to be generated
- Different types of technical writing
  - ❖ Proposals, Regulations, Manuals, Procedures, Requests, **Technical Reports**, Progress Reports, Emails, Memos
    - etc…
- Technical writing should be effective
  - ❖ Poor writing raises questions on the efficacy of the engineer
    - Background hard work should be sufficed with a effective technical report
  - ❖ May hinder career prospects as well

# What is Technical Report Writing?

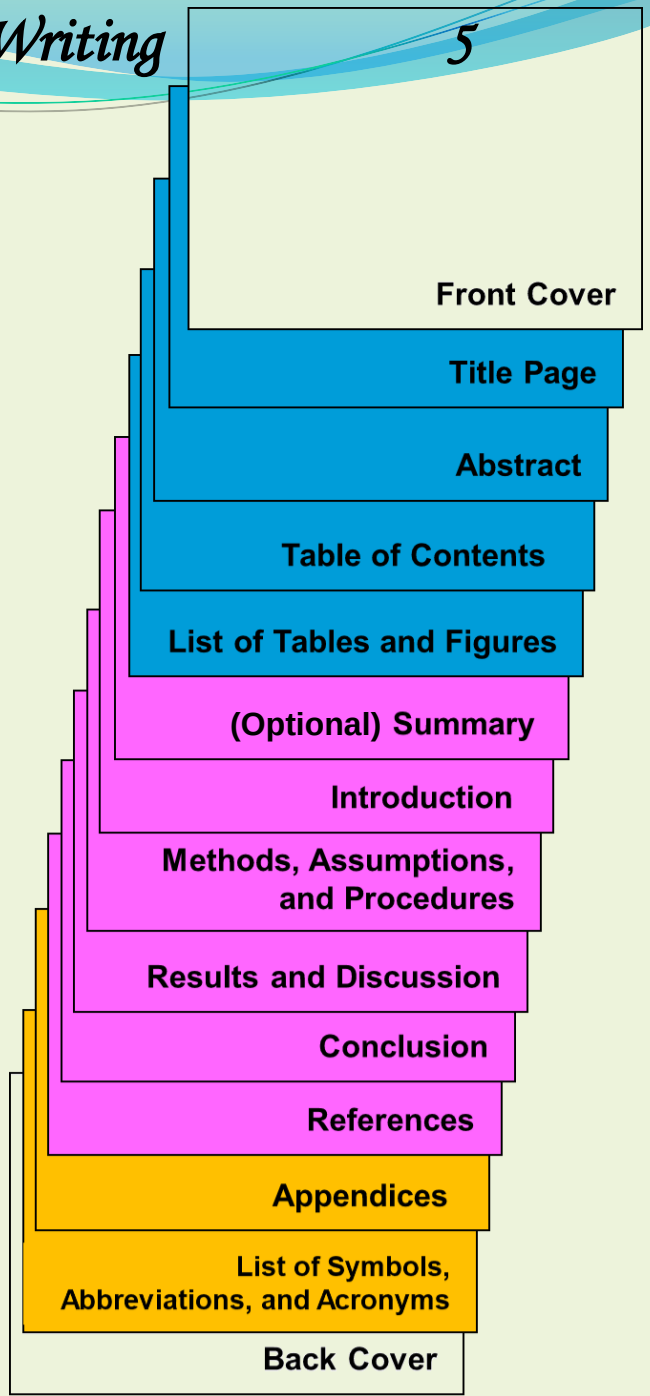
- A type of **expository** or **explanatory** writing that is used to convey information for technical or business purposes **(Newman, 2006)**

- Characteristics of Technical Report Writing
  - ❖ NOT meant to entertain
  - ❖ NOT meant to create suspense
  - ❖ CAN invite differing opinions or interpretations
  - ❖ Should follow some specific layout or some standardized format
    - American National Standards Institute – ANSI/NISO Z39.18-1995
  - ❖ Primary purpose of Technical Report
    - Disseminate the results of scientific and technical research and to recommend action based on the findings

# Layout of a Technical Report

- Layout is an important aspect
  - Novel → People generally reads from cover to cover
  - Technical Report → People should know where to go to fetch the desired information and obtain the necessary inferences

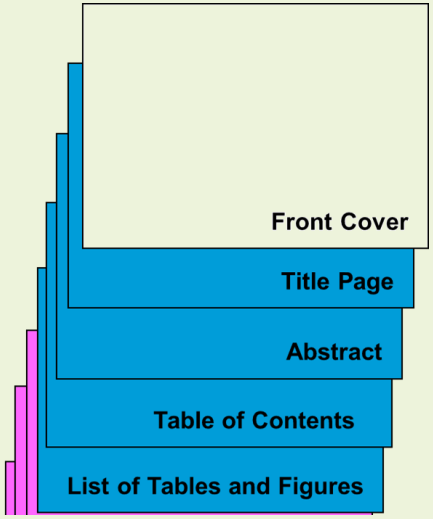
- Three major parts of a technical report
  - Front matter
  - Body / Text of the Report
  - Back matter




# Front Matter

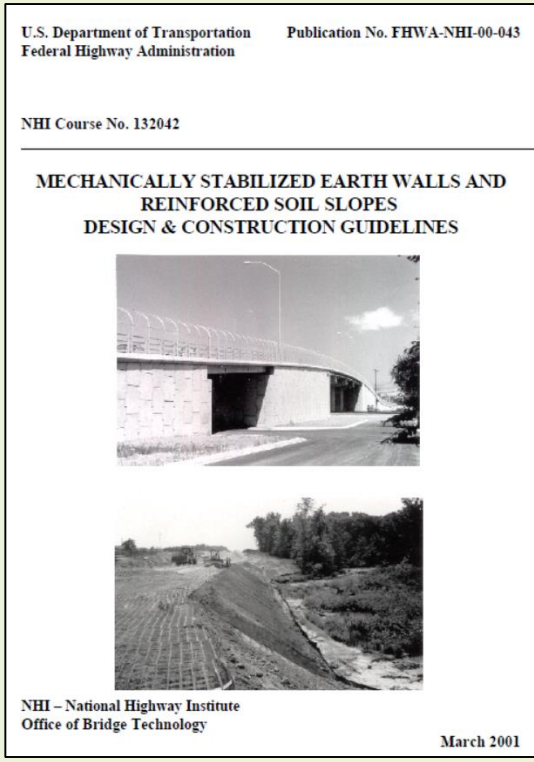
- Importance of the front matter
  - ❖ Helps the potential readers what to expect and find in the report
    - Take decision about its relevance against the requirement
  - ❖ Provides information to catalogue the report for bibliographic databases

- Components of front matter
  - ❖ Cover and/or Label (Optional)
  - ❖ Title Page (may contain authors details and affiliations)
  - ❖ Abstract
  - ❖ Table of Contents
  - ❖ List of Figures and Tables
  - ❖ List of Symbols, Abbreviations and Acronyms (may form the back matter)
  - ❖ Foreword, Certificate, Preface and/or Acknowledgment (Optional)



# Front Matter: Cover & Label

- Cover (Front and Back)
  - Generally used when a report is more than 10 pages long
    - These are not associated with page numbers
  - Provides physical protection to printed report
    - Plastic, Spiral binding, thick card-stock paper etc.
  - May come with some notices
    - Security classification, restricted distribution, or proprietary and regulatory information
- Label on the cover for identifying
  - Report title and/or subtitle (wherever applicable)
  - Author's name
  - Publisher / School and Class title
  - Date of publication
  - Report tracking number as per company standards (if any)



U.S. Department of Transportation
Federal Highway Administration

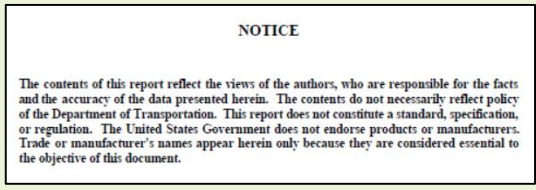
Publication No. FHWA-NHI-00-043

NHI Course No. 132042

MECHANICALLY STABILIZED EARTH WALLS AND REINFORCED SOIL SLOPES
DESIGN & CONSTRUCTION GUIDELINES

NHI – National Highway Institute
Office of Bridge Technology

March 2001

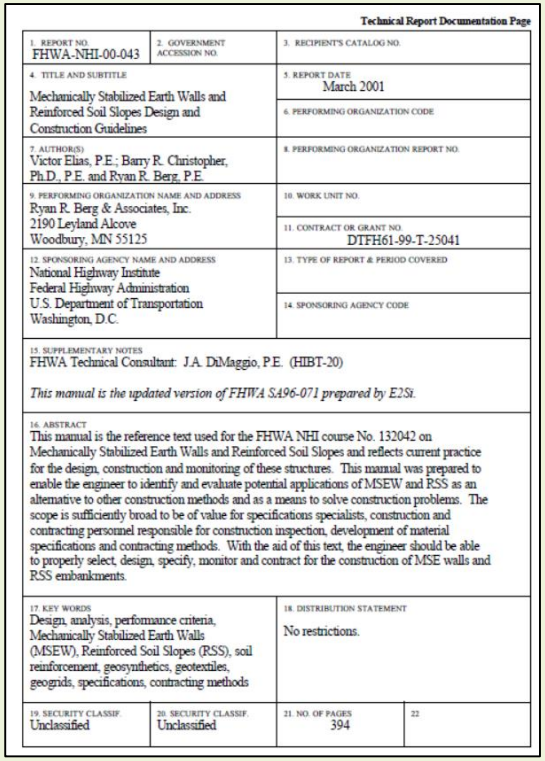


NOTICE

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect policy of the Department of Transportation. This report does not constitute a standard, specification, or regulation. The United States Government does not endorse products or manufacturers. Trade or manufacturer's names appear herein only because they are considered essential to the objective of this document.

# Front Matter: Title Page

- Provides descriptive information for libraries, abstracting and indexing agencies, and cataloguing databases
  - Sometimes duplicates information from front cover
- Components of title page
  - Title and/or subtitle
    - Should contain distinctive and distinguishing words
    - Avoid generic writing as 'A Report on…'
    - Abbreviations, if present, should be spelt out
  - Authorship in specific format
    - Sequence should follow the extent of contribution
    - Corresponding author, if applicable, should be marked
  - Report Number (if applicable)
  - Performing or Sponsoring organizations, if any

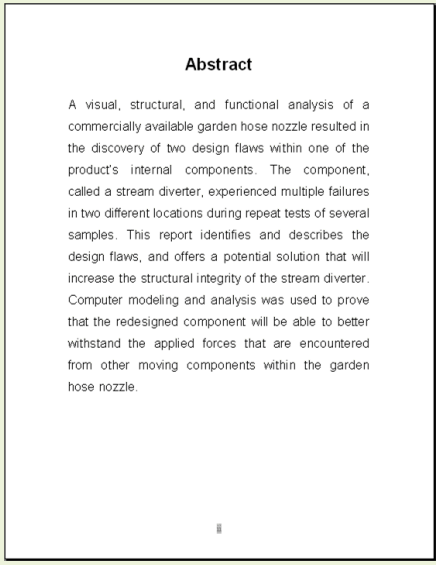


**Technical Report Documentation Page**

| | | |
|---|---|---|
| 1. REPORT NO.<br>FHWA-NHI-00-043 | 2. GOVERNMENT ACCESSION NO. | 3. RECIPIENT'S CATALOG NO. |
| 4. TITLE AND SUBTITLE<br>Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines | | 5. REPORT DATE<br>March 2001<br>6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S)<br>Victor Elias, P.E.; Barry R. Christopher, Ph.D., P.E. and Ryan R. Berg, P.E. | | 8. PERFORMING ORGANIZATION REPORT NO. |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>Ryan R. Berg & Associates, Inc.<br>2190 Leyland Alcove<br>Woodbury, MN 55125 | | 10. WORK UNIT NO.<br>11. CONTRACT OR GRANT NO.<br>DTFH61-99-T-25041 |
| 12. SPONSORING AGENCY NAME AND ADDRESS<br>National Highway Institute<br>Federal Highway Administration<br>U.S. Department of Transportation<br>Washington, D.C. | | 13. TYPE OF REPORT & PERIOD COVERED<br>14. SPONSORING AGENCY CODE |
| 15. SUPPLEMENTARY NOTES<br>FHWA Technical Consultant: J.A. DiMaggio, P.E. (HIBT-20)<br>*This manual is the updated version of FHWA SA96-071 prepared by E2Si.* | | |
| 16. ABSTRACT<br>This manual is the reference text used for the FHWA NHI course No. 132042 on Mechanically Stabilized Earth Walls and Reinforced Soil Slopes and reflects current practice for the design, construction and monitoring of these structures. This manual was prepared to enable the engineer to identify and evaluate potential applications of MSEW and RSS as an alternative to other construction methods and as a means to solve construction problems. The scope is sufficiently broad to be of value for specifications specialists, construction and contracting personnel responsible for construction inspection, development of material specifications and contracting methods. With the aid of this text, the engineer should be able to properly select, design, specify, monitor and contract for the construction of MSE walls and RSS embankments. | | |
| 17. KEY WORDS<br>Design, analysis, performance criteria, Mechanically Stabilized Earth Walls (MSEW), Reinforced Soil Slopes (RSS), soil reinforcement, geosynthetics, geotextiles, geogrids, specifications, contracting methods | | 18. DISTRIBUTION STATEMENT<br>No restrictions. |
| 19. SECURITY CLASSIF.<br>Unclassified | 20. SECURITY CLASSIF.<br>Unclassified | 21. NO. OF PAGES<br>394 |

# Front Matter: Abstract

- A short gist that gives an overview of the report
- Types of abstracts
  - ❖ Short abstract
    - Simple description of report's main topic and purpose
    - Broadest idea with no major facts being reported
    - Often few sentences long, as a footnote in the title page
  - ❖ Informative or Descriptive abstract
    - Describe the purpose, scope, and findings contained in the report
      - Purpose - identifies the issue, need, or reason for the investigation
      - Scope - reviews the main points, extent and limits of the investigation
      - Findings - includes condensed conclusions and recommendations
    - Generally not exceeding 300 words with NO citation to references
  - ❖ Extended abstract
    - May be 2-page or 3-page long (as required), and may even contain graphical illustrations and limited number of references



Abstract

A visual, structural, and functional analysis of a commercially available garden hose nozzle resulted in the discovery of two design flaws within one of the product's internal components. The component, called a stream diverter, experienced multiple failures in two different locations during repeat tests of several samples. This report identifies and describes the design flaws, and offers a potential solution that will increase the structural integrity of the stream diverter. Computer modeling and analysis was used to prove that the redesigned component will be able to better withstand the applied forces that are encountered from other moving components within the garden hose nozzle.

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# Front Matter: Table of Contents

- Lists the title and commencing page number of each major section in the report
  - ❖ Does not include the title page and ToC
  - ❖ NO need to include all headings and subheadings
    - Generally the 4th level subheadings are avoided
    - If a subheading is included, then all the same level subheadings SHOULD BE included
  - ❖ Page numbers
    - Follow lowercase ROMAN numerals for front matters
    - Follow Arabic numerals for all the pages thereafter
    - Title page is considered 'special' and NO page number is associated with it

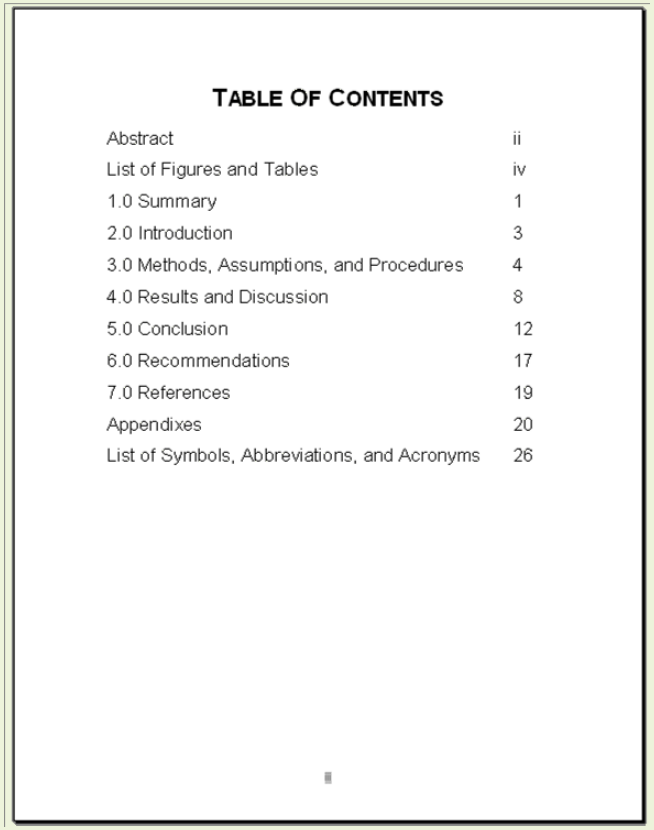
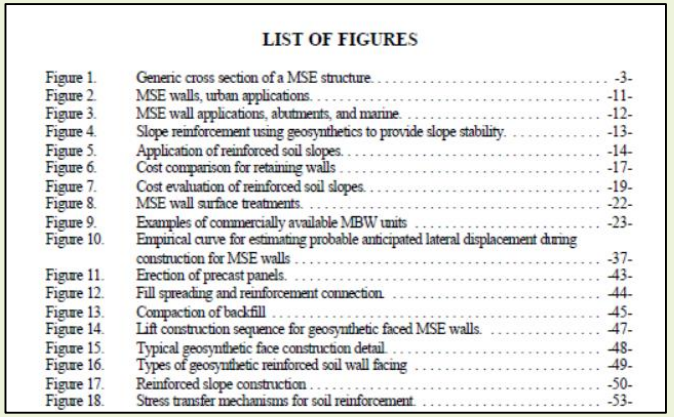


TABLE OF CONTENTS

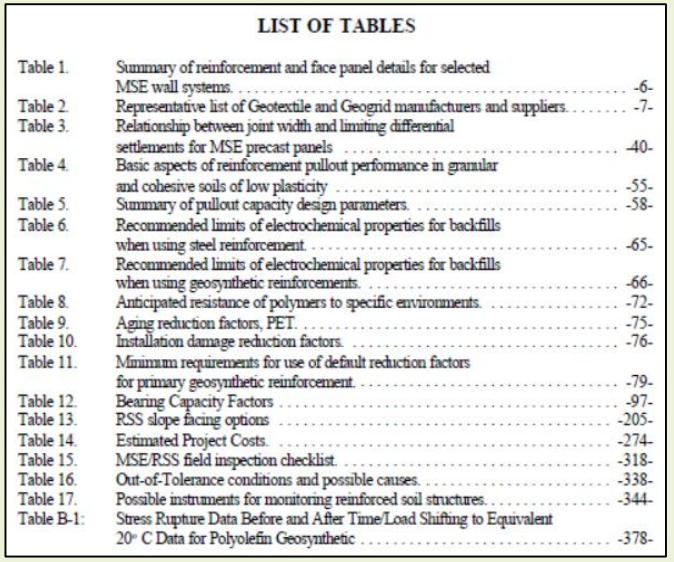
# Front Matter: List of Figures and Tables

- Helps the reader to locate illustrations, drawings, photographs, graphs, charts, and tables of information contained in the report
  - ❖ Provided after the ToC
  - ❖ List of Figures is followed by the List of Tables, each starting from a fresh page
  - ❖ All figures and tables are provided with their page numbers in the report for easy tracing
  - ❖ If the numbers of figures and tables are less than five, the lists of figures and tables can be avoided



LIST OF FIGURES





LIST OF TABLES

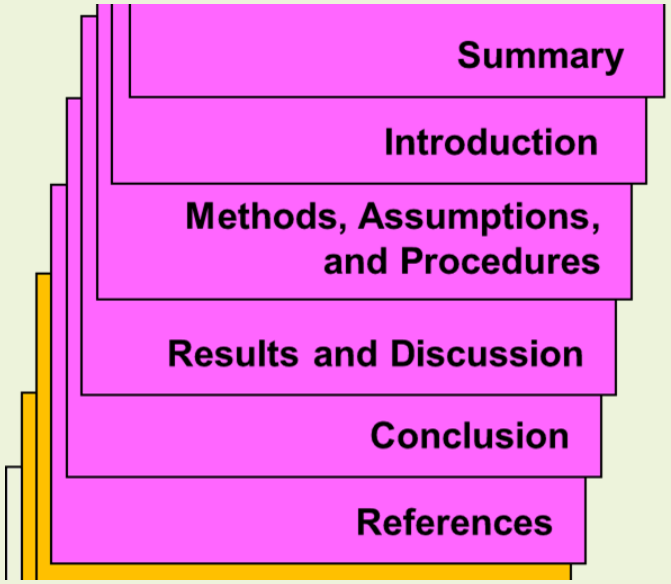
# Additional / Optional Front Matters

- Foreword
  - An introductory statement that presents background material
  - Generally written by an authority in the field, other than the author of the report
  - Name and affiliation of the author of the foreword follow the last paragraph
- Preface
  - An introductory statement announcing the purpose and scope of the report
  - Acknowledges the contributions of individuals not identified as authors or editors.
  - A preface may specify the audience for whom a report is intended
  - May also highlight the relationship of the report to a specific project or program.
  - Foreword precedes the Preface (if both are included)
- Acknowledgments
  - Highlighting the persons who have rendered technical assistance

# Text / Body of the Report

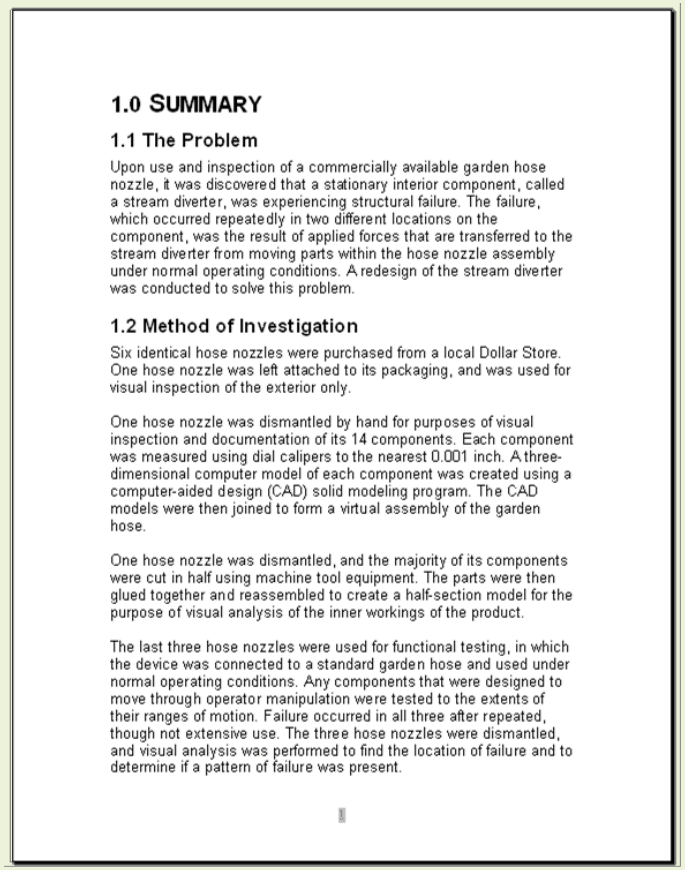
- Purposes of the text or body of the report
  - ❖ Describes the methods, assumptions, and procedures
  - ❖ Presents and discusses the results
  - ❖ Draws conclusions, and recommends actions based on the results

- Various components of text
  - ❖ Summary (Optional)
  - ❖ Introduction
  - ❖ Methods, Assumptions and Procedures
  - ❖ Results and Discussions
  - ❖ Figures and Tables (as and when required)
  - ❖ Recommendations (Optional)
  - ❖ References



# Text: Summary

- Purpose of a Summary
  - ❖ Briefly states the problem, method of investigation, conclusions, and recommendations
  - ❖ Contains no new info that is not contained in the report
  - ❖ Does not contain references
  - ❖ Length of summary generally does not exceed 2% of the body of the report
  - ❖ Differs from abstract in purpose and length



**1.0 SUMMARY**

**1.1 The Problem**

Upon use and inspection of a commercially available garden hose nozzle, it was discovered that a stationary interior component, called a stream diverter, was experiencing structural failure. The failure, which occurred repeatedly in two different locations on the component, was the result of applied forces that are transferred to the stream diverter from moving parts within the hose nozzle assembly under normal operating conditions. A redesign of the stream diverter was conducted to solve this problem.

**1.2 Method of Investigation**

Six identical hose nozzles were purchased from a local Dollar Store. One hose nozzle was left attached to its packaging, and was used for visual inspection of the exterior only.

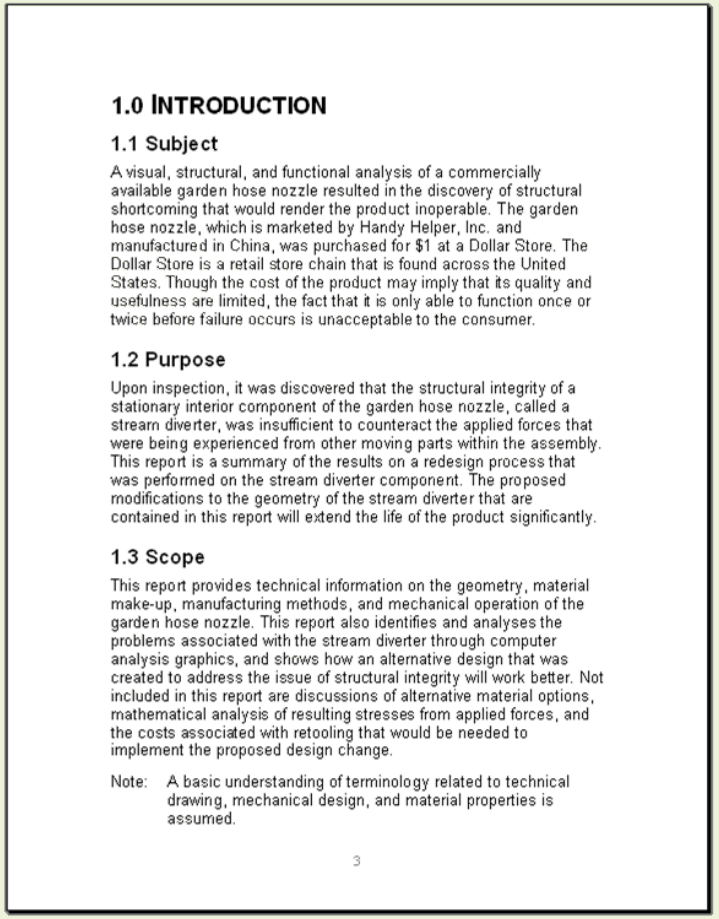
One hose nozzle was dismantled by hand for purposes of visual inspection and documentation of its 14 components. Each component was measured using dial calipers to the nearest 0.001 inch. A three-dimensional computer model of each component was created using a computer-aided design (CAD) solid modeling program. The CAD models were then joined to form a virtual assembly of the garden hose.

One hose nozzle was dismantled, and the majority of its components were cut in half using machine tool equipment. The parts were then glued together and reassembled to create a half-section model for the purpose of visual analysis of the inner workings of the product.

The last three hose nozzles were used for functional testing, in which the device was connected to a standard garden hose and used under normal operating conditions. Any components that were designed to move through operator manipulation were tested to the extents of their ranges of motion. Failure occurred in all three after repeated, though not extensive use. The three hose nozzles were dismantled, and visual analysis was performed to find the location of failure and to determine if a pattern of failure was present.

# Text: Introduction

- Prepares the reader to read the main body of the report
- This section focuses on the subject, purpose, and scope of the report
  - Subject - Defines the topic and associated terminology; may include theory, historical background, and its significance
  - Purpose - Indicates the reason for the investigation
  - Scope - Indicates the extent and limits of the investigation



## 1.0 INTRODUCTION

### 1.1 Subject

A visual, structural, and functional analysis of a commercially available garden hose nozzle resulted in the discovery of structural shortcoming that would render the product inoperable. The garden hose nozzle, which is marketed by Handy Helper, Inc. and manufactured in China, was purchased for $1 at a Dollar Store. The Dollar Store is a retail store chain that is found across the United States. Though the cost of the product may imply that its quality and usefulness are limited, the fact that it is only able to function once or twice before failure occurs is unacceptable to the consumer.

### 1.2 Purpose

Upon inspection, it was discovered that the structural integrity of a stationary interior component of the garden hose nozzle, called a stream diverter, was insufficient to counteract the applied forces that were being experienced from other moving parts within the assembly. This report is a summary of the results on a redesign process that was performed on the stream diverter component. The proposed modifications to the geometry of the stream diverter that are contained in this report will extend the life of the product significantly.

### 1.3 Scope

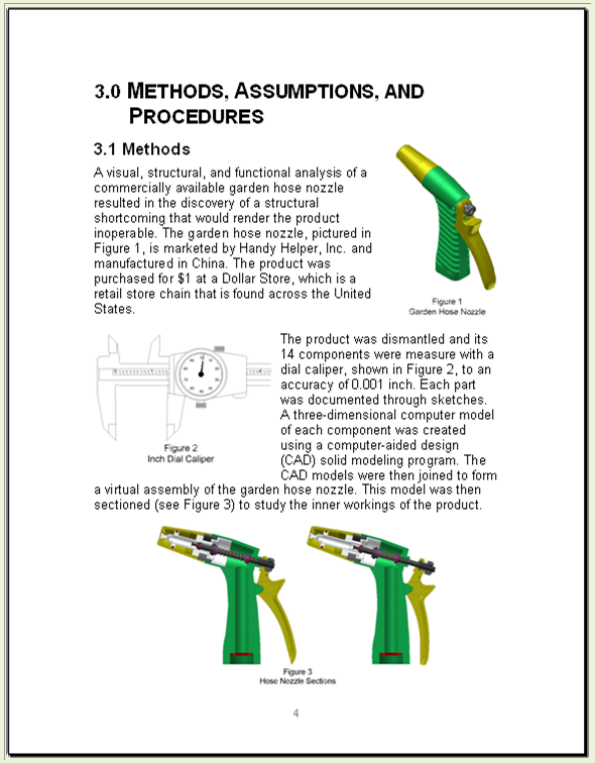
This report provides technical information on the geometry, material make-up, manufacturing methods, and mechanical operation of the garden hose nozzle. This report also identifies and analyses the problems associated with the stream diverter through computer analysis graphics, and shows how an alternative design that was created to address the issue of structural integrity will work better. Not included in this report are discussions of alternative material options, mathematical analysis of resulting stresses from applied forces, and the costs associated with retooling that would be needed to implement the proposed design change.

Note: A basic understanding of terminology related to technical drawing, mechanical design, and material properties is assumed.

3

# Text: Methods, Assumptions and Procedures

- Detailed description of the methods, assumptions, working principles and procedures is extremely necessary
  - The description should aid the reader to replicate the procedures of the investigation with ease
- Information in this section
  - System of measurement
  - Adopted working procedure
  - Thorough discussion on background assumptions
  - Types of equipment used and their accuracy
  - Utilized test methods and protocols
  - Description of the numerical techniques
  - Brief description of the numerical software and its references (if used)



3.0 METHODS, ASSUMPTIONS, AND PROCEDURES

3.1 Methods

A visual, structural, and functional analysis of a commercially available garden hose nozzle resulted in the discovery of a structural shortcoming that would render the product inoperable. The garden hose nozzle, pictured in Figure 1, is marketed by Handy Helper, Inc. and manufactured in China. The product was purchased for $1 at a Dollar Store, which is a retail store chain that is found across the United States.

Figure 1
Garden Hose Nozzle

Figure 2
Inch Dial Caliper

The product was dismantled and its 14 components were measure with a dial caliper, shown in Figure 2, to an accuracy of 0.001 inch. Each part was documented through sketches. A three-dimensional computer model of each component was created using a computer-aided design (CAD) solid modeling program. The CAD models were then joined to form a virtual assembly of the garden hose nozzle. This model was then sectioned (see Figure 3) to study the inner workings of the product.

Figure 3
Hose Nozzle Sections

4

# Text: Figures and Tables

- Figure
  - Any drawing photograph, graph, or chart that is used to explain and support the technical information in the text
    - Any text within the figure should be clearly legible and should have near similar font size with that used in the text
    - Figure number and caption should appear below the image
    - Figure to be placed close to the textual reference (unless otherwise specified)

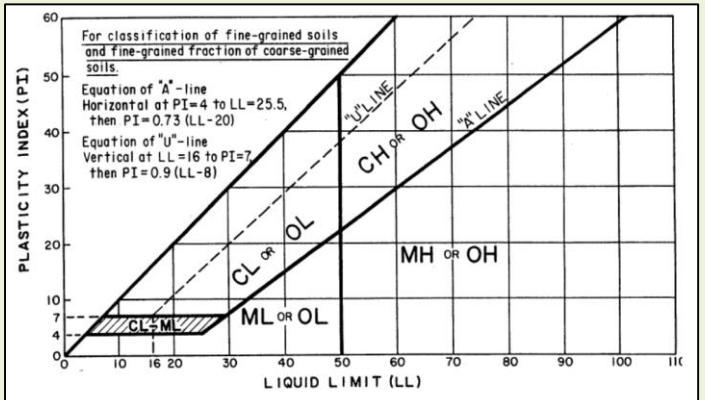


Figure 4-3. Plasticity chart for Unified Soil Classification System (ASTM D 2487).

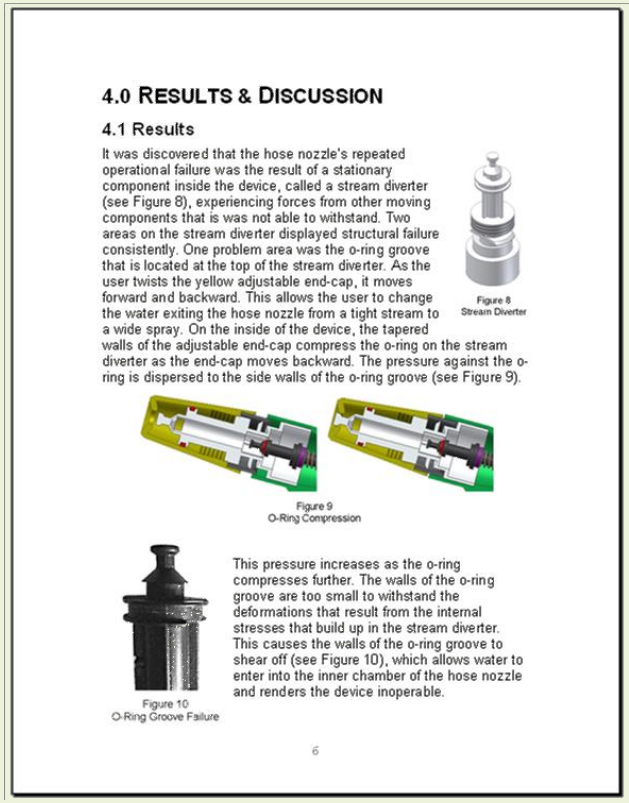
- Table
  - An arrangement of detailed facts or statistics that are arranged in a row-and-column format
    - The table number and caption appear above the table

Table 4-1
Evaluation of the apparent density of coarse-grained soils (after Peck, *et al.*, 1974)

| $N_{60}$ | Apparent Density | Relative Density, % |
|---|---|---|
| 0 – 4 | Very loose | 0 – 20 |
| >4 - 10 | Loose | 20 – 40 |
| >10 - 30 | Medium dense | 40 – 70 |
| >30 - 50 | Dense | 70 – 85 |
| >50 | Very Dense | 85 – 100 |
| The above guidance may be misleading in gravelly soils. | | |

# Text: Results and Discussions

- An elaborate and descriptive section
  - ❖ Describes what is learnt about the problem as a result of research
  - ❖ Identifies the degree of accuracy related to the findings
  - ❖ Draws the inferences and provides the reader about the authors' view on the significance of the findings
    - Explanation of the results as to their accuracy and significance
    - Data essential to understanding the results may appear in numbered tables or figures as near the discussion as possible
    - Other non-essential data should appear in an appendix in the back material



4.0 RESULTS & DISCUSSION

4.1 Results

It was discovered that the hose nozzle's repeated operational failure was the result of a stationary component inside the device, called a stream diverter (see Figure 8), experiencing forces from other moving components that is was not able to withstand. Two areas on the stream diverter displayed structural failure consistently. One problem area was the o-ring groove that is located at the top of the stream diverter. As the user twists the yellow adjustable end-cap, it moves forward and backward. This allows the user to change the water exiting the hose nozzle from a tight stream to a wide spray. On the inside of the device, the tapered walls of the adjustable end-cap compress the o-ring on the stream diverter as the end-cap moves backward. The pressure against the o-ring is dispersed to the side walls of the o-ring groove (see Figure 9).

Figure 8
Stream Diverter

Figure 9
O-Ring Compression

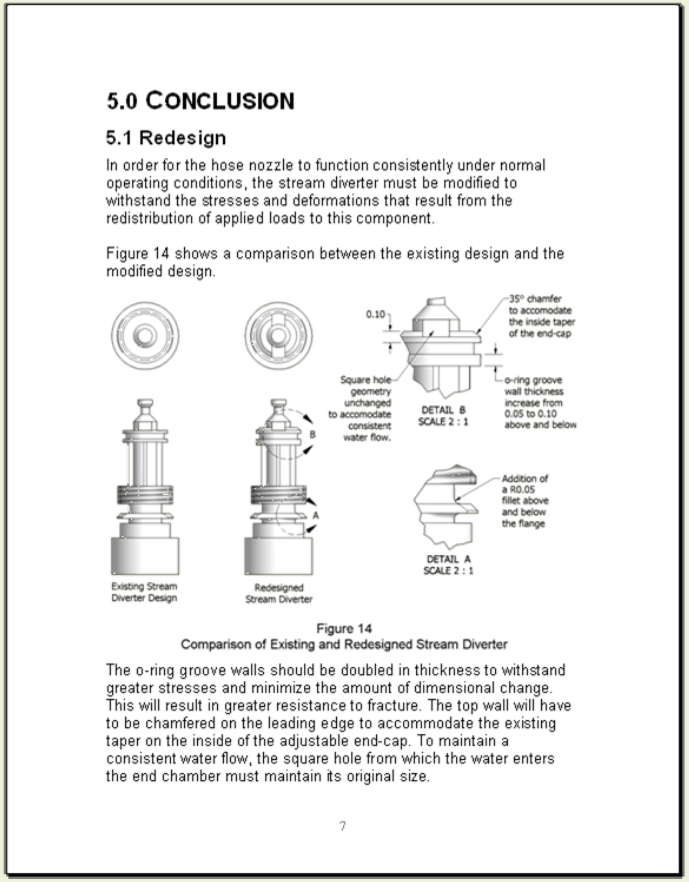
This pressure increases as the o-ring compresses further. The walls of the o-ring groove are too small to withstand the deformations that result from the internal stresses that build up in the stream diverter. This causes the walls of the o-ring groove to shear off (see Figure 10), which allows water to enter into the inner chamber of the hose nozzle and renders the device inoperable.

Figure 10
O-Ring Groove Failure

6

# Text: Conclusions

- Provides the hard deductions made from the findings, inferences and results
  - ❖ May be QUALITATIVE or QUANTITATIVE
    - Completely generic qualitative conclusions are not readily appreciated
  - ❖ NO NEW INFORMATION should be presented here
  - ❖ May have **Restatement of Results**
    - Statement of factual findings specific to the investigation
    - Implications of the factual findings
  - ❖ A set of **Concluding Remarks**
    - Conclusive opinions based on the findings and results



**5.0 CONCLUSION**

**5.1 Redesign**

In order for the hose nozzle to function consistently under normal operating conditions, the stream diverter must be modified to withstand the stresses and deformations that result from the redistribution of applied loads to this component.

Figure 14 shows a comparison between the existing design and the modified design.



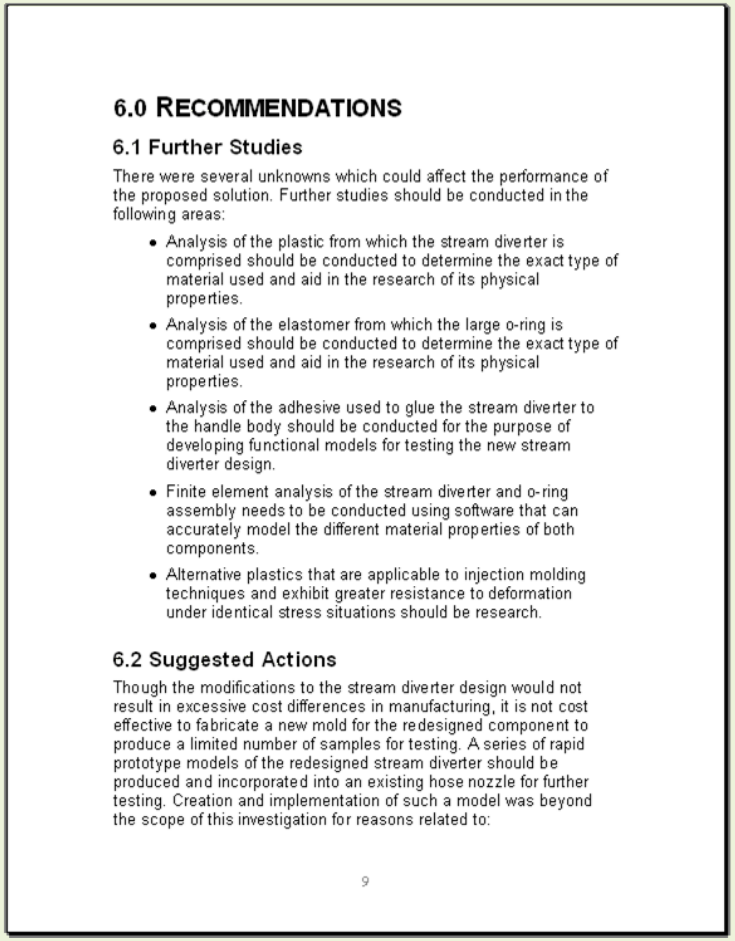
Figure 14
Comparison of Existing and Redesigned Stream Diverter

The o-ring groove walls should be doubled in thickness to withstand greater stresses and minimize the amount of dimensional change. This will result in greater resistance to fracture. The top wall will have to be chamfered on the leading edge to accommodate the existing taper on the inside of the adjustable end-cap. To maintain a consistent water flow, the square hole from which the water enters the end chamber must maintain its original size.

7

# Text: Recommendations

- An optional section often included in the engineering reports
  - ❖ Highlight the possible tests and experiments, field trials, specific design problems, and feasibility studies
    - Development of design guidelines or monographs based on the research findings
  - ❖ Is there information that still needs to be learned?
  - ❖ Is there any suggested actions that can be further adopted?
    - Recommend additional areas of study and suggest a course of action, such as pursuing an alternate design approach



**6.0 RECOMMENDATIONS**

**6.1 Further Studies**

There were several unknowns which could affect the performance of the proposed solution. Further studies should be conducted in the following areas:

- Analysis of the plastic from which the stream diverter is comprised should be conducted to determine the exact type of material used and aid in the research of its physical properties.
- Analysis of the elastomer from which the large o-ring is comprised should be conducted to determine the exact type of material used and aid in the research of its physical properties.
- Analysis of the adhesive used to glue the stream diverter to the handle body should be conducted for the purpose of developing functional models for testing the new stream diverter design.
- Finite element analysis of the stream diverter and o-ring assembly needs to be conducted using software that can accurately model the different material properties of both components.
- Alternative plastics that are applicable to injection molding techniques and exhibit greater resistance to deformation under identical stress situations should be research.

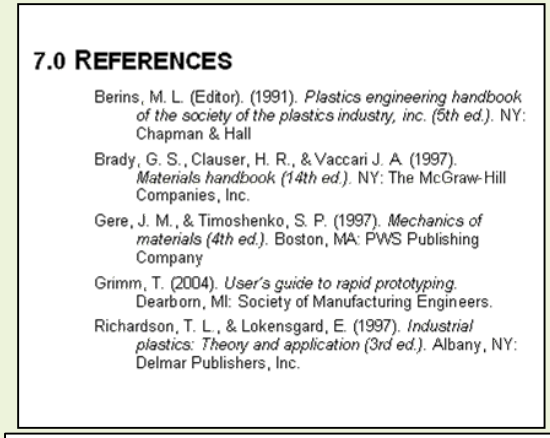
**6.2 Suggested Actions**

Though the modifications to the stream diverter design would not result in excessive cost differences in manufacturing, it is not cost effective to fabricate a new mold for the redesigned component to produce a limited number of samples for testing. A series of rapid prototype models of the redesigned stream diverter should be produced and incorporated into an existing hose nozzle for further testing. Creation and implementation of such a model was beyond the scope of this investigation for reasons related to:

9

# Text: Citation and References

- Section citing the secondary research resources that were used
  - To develop an understanding of the problem
  - To support the information contained in the report
  - To validate any findings from the conducted research
- Various referencing styles are available
  - APA, ASCE, Harvard, MHRA, Chicago, Turabian, IEEE etc.
  - Should piously follow a specific referencing style for a particular technical report
- Citation styles within the text
  - Numbered (as first appeared in the text)
  - Listed (Author/Year alphabetical order)
    - Should not mix between citation styles within a particular report



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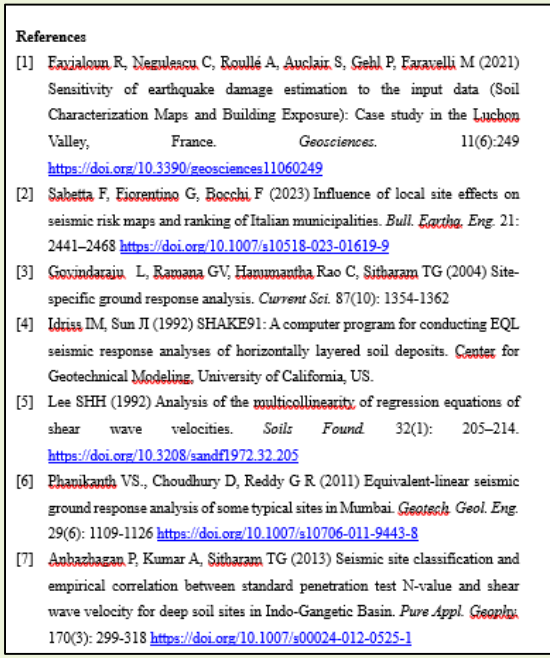

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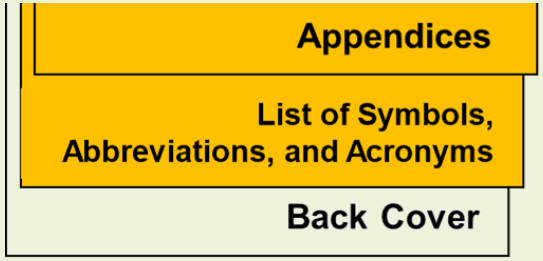
# Back Matter

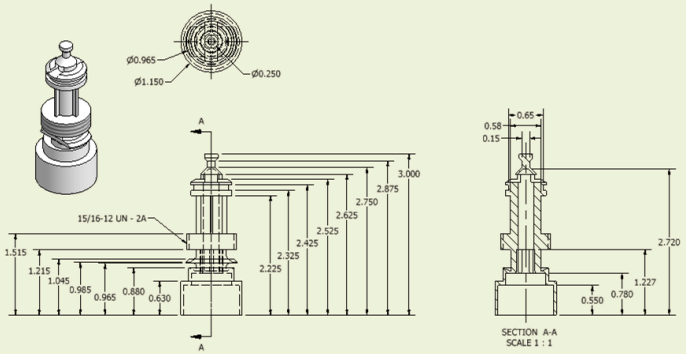
- Necessity and importance of back matter
  - ❖ Supplements and clarifies the body of the report
  - ❖ Makes the body text easier to understand
  - ❖ Shows where additional information can be found

- Components of back matter (many might be optional)
  - ❖ Appendices
  - ❖ Bibliography
  - ❖ List of symbols, abbreviations and acronyms (may be in front matter)
  - ❖ Glossary
  - ❖ Index
  - ❖ Distribution list



# Back Matter: Appendix(ces)

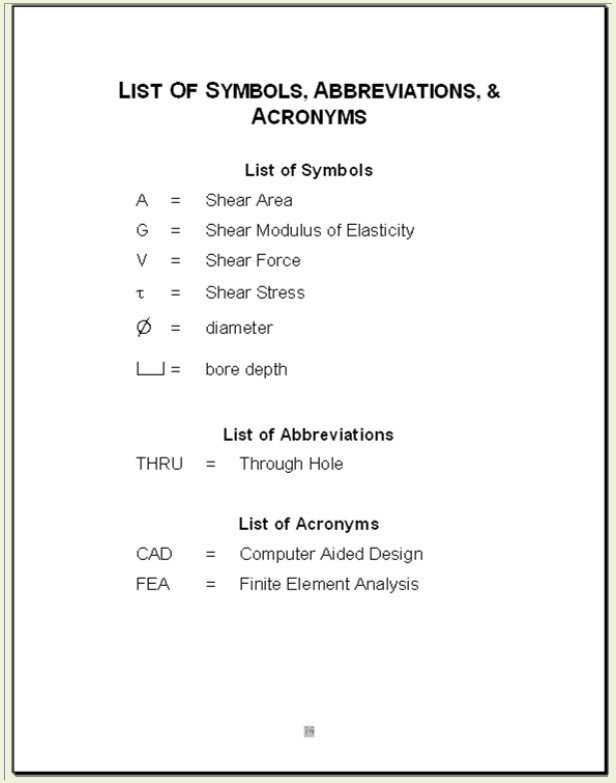
- Mostly contains additional information in lieu of the report
  - Anything that cannot be left out of a report, but is too large for the main part of the report and would serve to distract or interrupt the flow
- Appendix may comprise the following
  - Large tables of data
  - Flowcharts
  - Mathematical analysis
  - Large illustrations
  - Detailed explanations and descriptions of test techniques and apparatus
  - Technical drawings




- Each appendix should be cited serially in the text
  - The same serial should be followed while the appendices are referred

# Back Matter: List of Symbols, Abbreviations and Acronyms

- Provided in a tabular format
  - ❖ Symbols should be provided with their explanations
  - ❖ Abbreviations and acronyms should be provided with their full forms
  - ❖ Listing of symbols, abbreviations and acronyms should follow a specific order, preferably as follows
    - Roman (English) alphabet capital letters
    - Roman (English) alphabet lowercase letters
    - Greek alphabet capital letters
    - Greek alphabet lowercase letters
    - Subscripts
    - Superscripts
    - Special notes



**LIST OF SYMBOLS, ABBREVIATIONS, & ACRONYMS**

**List of Symbols**

| | | |
|---|---|---|
| A | = | Shear Area |
| G | = | Shear Modulus of Elasticity |
| V | = | Shear Force |
| τ | = | Shear Stress |
| Ø | = | diameter |
| ⌴ | = | bore depth |

**List of Abbreviations**

| | | |
|---|---|---|
| THRU | = | Through Hole |

**List of Acronyms**

| | | |
|---|---|---|
| CAD | = | Computer Aided Design |
| FEA | = | Finite Element Analysis |

# Optional Back Matter Content

- Bibliography
  - List of additional sources of information not referenced in the report
- Glossary
  - List of definition of technical terms used in the report
- Index(ing)
  - List of all major topics in alphabetical order
  - Provides references to the pages within the report where the topic appears
- Distribution list
  - The list indicates the business mailing address of the individuals and organizations receiving copies of the report and the number of copies received.
  - Distribution lists provide a permanent record of initial distribution

# Tips for Writing Research Articles

## Journals, Conferences, Book Chapters

## Remember the Purpose of the Research Article

- Explain problem or issue studied
- Discuss the research methodology
- Describe the data collected and the collection technique
- Describe the research findings with critical inferences
- Explain the implications of the study
- Mention limitations/shortfalls and Future scope

# Remember the Purpose of the Research Article

- **Inform the readers of the research results that should be**

  - **Precise**
  - **Concise**
  - **Specific**

**They shouldn’t have to read whole report to get essential points**

# Report Planning

- **Before writing, always consider the following**

❖ **Why are you writing?**

❖ **What do you hope to achieve?**

❖ **Who are you writing for?**

**These considerations will determine the report's content, organization, textual and visual design**

# Report Format and Organization

- **Methodology**
  - ❖ Explains how data was gathered/generated
  - ❖ Explains how data was analyzed
  - ❖ Assumes reader understands material
    - Does not include explanatory material, use Citations
  - ❖ Use of past tense and passive voice
    - "A 1" piece of coil was cut"
      - The research has been carried out
      - It is the research, and not your activities, that are of interest
        - Avoid the usage of I/We/He/She etc.

# Report Format and Organization

- **Results**
  - ❖ Visually and textual representation of research findings
    - Visual representation of results
      - Graphs
      - Tables
      - Diagrams
      - Charts
    - Associated explanatory text (NOT readouts)
      - Text points out the most significant portions of research findings
      - Indicates key trends or relationships
      - Highlights expected and/or unexpected findings

# Report Format and Organization

- **Discussions**
  - ❖ Assesses and comments on research results
  - ❖ Components of Discussion
    - Explanation for Results
      - Comments on unexpected results, offering hypothesis for them
    - Comparison to literature
      - Does your research confirm previous studies?
      - Or, Deviate from them?
    - Explanation for how info can be applied in broader context

# Report Format and Organization

- **Summary / Conclusions**
  - A brief collation of different implicative items
    - What was learned through research?
    - What remains to be learned?
    - Strengths of study
    - Weaknesses and shortcomings of study
    - Possible applications of study (how it can be used)
    - Recommendations

# Report Format and Organization

- **Background/Introduction**
  - ❖ Explains the research problem and its context
  - ❖ Explains importance of the problem
    - Why does it matter?
    - Why is more information needed?
  - ❖ Explains reason and goals for study
  - ❖ Explains the limitations of the research performed

**You want your reader to fully understand the significance of your research**

# Report Format and Organization

- **Literature Review**
  - Summarizes and evaluates the literature that you have used in your study by considering:
    - How that literature has contributed to your area of research?
    - The strengths and weaknesses of previous studies
    - How that literature informs your own research and understanding of the research problem
    - Motivation and Deciding the scope of your problem

# Report Format and Organization

- **Abstract**
  - ❖ Always comes first
  - ❖ Microcosm of entire paper – contains key info from each section
    - Contains essential information *only* – it is brief!
    - Covers research highlights
    - Gives the research problem and/or main objective of the research
    - Indicates the methodology used
    - Presents the main findings and conclusions

# Organizational Considerations

- **Your audience, purpose, and contents should influence your report organization and format**
  - ❖ Your supervisor may have very specific guidelines
  - ❖ The audience can be academicians or field personnel
  - ❖ The audience may be technical or non-technical
- **Carefully consider your decisions to frame and modulate the research article**

# Heading and Subheadings

- **Headings and subheadings guide readers' attention**
- **They should be**
  - ❖ Specific and helpful
  - ❖ Used to break up text and "chunk" information
- **Can be used to keep track of various parts of project**
  - ❖ For example: "Making Components," "Assembling Components," and "Testing Assembly" etc.
  - ❖ The audience may be technical or non-technical

# Heading and Subheadings

- **Headings should be specific**
- **Avoid vague headings**
  - **Example of vague heading**
    - "The use of some computing technologies in certain engineering classrooms"
  - **Example of specific heading**
    - "Using Matlab in the Freshman engineering classroom"

# Language and Vocabulary

- **Reports should be easily accessible and understandable**
  - Be straightforward and concise
  - Use simple terms, not jargon and non-technical terms
  - Keep sentences short and simple (20 words max, 2.5 lines max)
    - Avoid too long compound sentences
  - Be specific and not general
    - Use concrete numbers and metaphors or similes

# Visual Design

- **A report's visual design can make or break its communication success**

- **Visual Design includes**
  - ❖ Use of graphs and other graphics
  - ❖ Use of white space

# Visual Design

- **Graphics**
  - Should be used to illustrate specific points
  - Should be incorporated in a way that is natural to report's content/context
  - Should be explained fully in text using references such as "Fig. 1 shows…"
  - Should be cited if taken from a source
- **Graphics – a caveat**
  - A picture speaks 1000 words
  - Graphics do not completely speak for themselves!
    - Textual information should come before graphics

# Visual Design

- **White Spaces**
  - ❖ General layout should focus readers on key information
    - Use white space to guide readers' attention
      - Created through use of headings, subheadings, and visuals
  - ❖ Examples
    - A line left out after each heading/sub-heading
    - A line left out before after a table or figure (including the captions)
    - Any subjective distinctiveness brought out by the author which can be thought to provide a clarifying perspective to the reader

# Source Documentation

- **Cite sources whenever you are quoting, paraphrasing, or summarizing work that is not your own or already published**
  - Quoting directly is discouraged
  - Even self quoting needs to be cited
- **Sources include**
  - Books
  - Journal, magazine, or newspaper articles
  - Interviews
  - Conference Proceedings
  - Lectures
  - Theses and Documentations
  - Unpublished literatures*

# Source Documentation

- **Citing / Citation**
  - Shows your credibility as a researcher
  - Gives proper credit to authors and researchers
  - Protects you from accusations of plagiarism
- **Various citation formats available**
  - APA, AISC etc. etc.
- **Various style guides available online**
  - http://owl.english.purdue.edu, http://www.apastyle.org/
- **Check journals/conferences for format info**

# Finishing Touches

- **Usability Testing**
  - ❖ Have a colleague read your report for clarity, organization, and visual design
- **Check/Recheck your sources for proper citations**
- **Proofread carefully**
  - ❖ Better yet, ask someone to do it for you
- **Similarity Indices and Plagiarism Check**
  - ❖ Check even the self-plagiarism and self-referencing
  - ❖ Software like Turnitin, Urkund, Crossref, … etc.

# Referencing

- **Various reference formats available**
- **Journals and conferences have specific formatting**

# Final Remark

**Technical Report should be technically sound**

**Technical Report should be informatively correct**

**Technical Report should be unambiguous and succinct**

**Technical Report should be visually and aesthetically appealing**

**Technical Report Writing should establish the authors' credibility**

# Some Relevant References

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Thank You for Patient Hearing