Minnesota Department of Transportation
General Guidelines for Publication of Research Reports
MINNESOTA DEPARTMENT OF TRANSPORTATION

GENERAL GUIDELINES FOR
PUBLICATION OF RESEARCH REPORTS

Prepared by
Micky Ruiz
Kim Troedsson

Minnesota Department of Transportation
Office of Research Administration
200 Ford Building Mail Stop 330
117 University Avenue
St. Paul, MN 55155

March 1995
# TABLE OF CONTENTS

Chapter 1  INTRODUCTION .................................................. 1

Chapter 2  MAJOR TEXT ELEMENTS OF THE RESEARCH REPORT ...... 3

- Organization of the Major Text Elements ................................. 3
- Report Cover ................................................................. 3
- Funding Acknowledgements .................................................. 4
- Technical Report Documentation Page ................................. 4
- Title Page ............................................................................ 5
- Acknowledgements .................................................................. 5
- Table of Contents ............................................................... 5
- Executive Summary ............................................................. 6
- Introduction ......................................................................... 7
- Report Body ......................................................................... 8
- References ........................................................................... 9
- Appendix(es) ....................................................................... 9

Chapter 3  VISUAL AND TYPOGRAPHICAL FEATURES .............. 11

- Document Format ............................................................... 11
  - Font .................................................................................. 11
  - Line Spacing ..................................................................... 11
  - Margins ............................................................................. 11
  - Dangling Lines .................................................................. 11
  - Abbreviations, Acronyms, and Symbols ............................... 11
- Page Numbering ................................................................. 12
- Page Order .......................................................................... 12
- Un-numbered Pages ............................................................ 12
- Single-Sided Versus Double-Sided Pages ............................... 13
- Right Page and Left Page Format .......................................... 13
- Software Capability for Page Numbering ............................... 14

Chapter 4  GRAPHICS ............................................................. 15

- Introduction ....................................................................... 15
- Photos ............................................................................... 15
The Minnesota Department of Transportation (Mn/DOT) research report is the key document for a researcher to present research results, transfer knowledge to users, and encourage possibilities to implement research. If these aims are to be achieved, it is important for report authors to produce a well-organized and clearly-written document. The Mn/DOT Office of Research Administration (ORA) has developed this document, General Guidelines for the Publication of Research Reports, to aid the author in writing and constructing the research report. Following the guidelines will also ensure the quality and consistency of presentation in all Mn/DOT research reports.

Another benefit to the author is that observance of the guidelines during the writing process will expedite publication of the research report. The process of publishing research reports involves an interactive review and revision process between ORA and the author (see Chapter 6 Submittal of the Research Report for details). This method requires time for ORA to review the report draft and make editorial comments to be forwarded to the author for potential revision. A main goal of the guidelines is to expedite the review process by providing direction before the final draft is completed. Time may be saved by eliminating the need for revisions when authors adhere to the guidelines prior to the editorial review.

Authors should use Mn/DOT guidelines for all research reports published by Mn/DOT. Research funded either wholly or partially by the Federal Highway Administration (FHWA) must adhere to DOT-TST-75-97 (PB 245400) Standards for the Preparation and Publication of DOT Scientific and Technical Reports. FHWA standards are more specific and should be used in lieu of Mn/DOT guidelines when writing reports for FHWA funded projects. To obtain copies of DOT-TST-75-97 (PB 245400), contact the Mn/DOT Office of Research Administration, 117 University Avenue, Saint Paul, Minnesota 55155, (phone 612-282-2274).
The guidelines are divided into three sections: 1) Major Text Elements of the Research Report; 2) Visual and Typographical Features, Graphics and Supporting Material; and 3) Submittal of the Research Report. Report authors will most likely find it useful to become familiar with the information in each section; however, the section on Visual and Typographical Features, Graphics and Supporting Material is intended to serve as a special aid to the typist or word processor in typing and formatting.

The document you are reading has been designed for use as a visual guide; it duplicates the desired format of a Mn/DOT research report.

While the guidelines are intended to be comprehensive, they may not answer all of the writer’s questions. In this regard Mn/DOT strongly encourages authors to contact ORA for any direction or clarification of the guidelines prior to the report review process. Please direct any questions to:

Micky Ruiz
Technology Transfer Manager
Office of Research Administration
Phone: (612) 282-2269
CHAPTER 2

MAJOR TEXT ELEMENTS OF THE RESEARCH REPORT

ORGANIZATION OF THE MAJOR TEXT ELEMENTS

Organization of the report may vary depending on its subject, length and complexity. However, in most situations reports should contain the following elements in order as shown below. Unless noted as "optional," all elements are required to be included in the Mn/DOT research report format:

1) Report Cover (furnished by Mn/DOT)
2) Funding Acknowledgements (inside front cover; optional)
3) Technical Report Documentation Page
4) Title Page
5) Acknowledgements (optional)
6) Table of Contents (not required for reports less than ten pages)
7) Executive Summary
8) Introduction (if written as a separate section from the report body)
9) Report Body (may include the introduction as the first chapter)
10) References
11) Appendix(es) (optional)

Comments and direction on each of the above elements are given below in the same order as they are listed.

REPORT COVER

ORA is responsible for producing the front and back pages of the Report Cover. In order to maintain consistency in the appearance of Mn/DOT research reports and to facilitate recognition, a standard cover design format has been created which contains certain standard features such as logos, report number, etc. Within certain guidelines, the features of the Report Cover may be varied to add artistic style to the Report Cover. At one of the meetings of the Technical
Advisory Panel (TAP), the ORA representative and the author will solicit input from the TAP members for the front cover design for the report. Please note the following:

- Mn/DOT's standard design format for the report cover includes the report number (assigned by ORA), title, and applicable logos from specific Mn/DOT programs, cooperative projects, and/or the LRRB, for example.
- The use of photos and/or a graphic illustration for the cover design is recommended to add interest and style to the report. In most cases, the author will provide the photo for the report cover. If the author prefers to use graphics on the cover but does not have a graphics designer available, Mn/DOT's Graphics Unit may produce the graphic illustration.
- All design features should be determined prior to submittal of the final report for printing.

Note that for internally conducted research projects where no TAP has been established, the cover design will be developed by ORA and the Mn/DOT office responsible for writing the report.

FUNDING ACKNOWLEDGEMENTS
Acknowledging funding sources is optional, but, if desired, such sources may be stated on the inside of the front cover. See Appendix A for examples. ORA may provide the necessary information regarding a project's funding sources.

TECHNICAL REPORT DOCUMENTATION (TRD) PAGE
The Technical Report Documentation Page is the key information source for input into research databases and library catalogues that provide interested parties access to research results. The most notable of these include the Transportation Research Information Services (TRIS) and the National Technical Information Service (NTIS). The information on the TRD page is also used for entry into Mn/DOT's research database, as well as for cataloging in other libraries which
receive copies of Mn/DOT reports. An example and instructions for completing the TRD page are shown in Appendix B. If a report consists of separate volumes, a TRD page is needed for each volume.

**TITLE PAGE**
The title page should state the following in vertical order:

1) Title of the report. (interim report, final report, executive summary, other)
2) Author’s name(s).
3) Name and address of the organization(s) represented by the author(s).
4) Date (month/year) of publication.
5) Name of the organization that is publishing the report.
6) Any applicable disclaimers.

See Appendix C for title page layout and examples of title pages using various disclaimers. Use the format shown on these examples and choose font styles and sizes that are complementary to those used in the text of the report.

**ACKNOWLEDGEMENTS**
Besides acknowledging funding sources as explained previously, the author may want to devote a separate page for identifying other persons and/or organizations that have made a significant contribution to the work. The Acknowledgements Page may be used to recognize these people and/or organizations and the nature of their contributions if desired. The entire acknowledgement should be no longer than about a third of a page or it loses the reader’s interest. See Appendix D for examples.

**TABLE OF CONTENTS**
General rules for the Table of Contents are as follows and are illustrated by example in Appendix E:
• Reports consisting of ten pages or less do not require a table of contents.
• Titles for each chapter listing should read exactly as in the text.
• If chapters are written separately by different authors, their names should not appear in the Table of Contents, but should be noted under the appropriate chapter heading in the report body.
• The Table of Contents should not include a listing of any pages which are not numbered (see page 12 for a list of pages which are not numbered).
• Table of Contents pages are not numbered.
• Appendices should be included in the Table of Contents.
• Lists of Tables and Figures may follow the Table of Contents on a separate page or pages titled "List of Figures" and "List of Tables." In cases where the report and (presumably) the Table of Contents are short in length, the Lists of Tables and Figures may be located at the end of the Table of Contents rather than on a separate page. In any case tables and figures should be listed in sequential order by table or figure number and corresponding page number.

EXECUTIVE SUMMARY
Executive Summaries are required for all Mn/DOT reports. The Executive Summary highlights the research project’s most essential points for those readers who may not have time to read the entire report. In this respect, it should be able to stand on its own as a document. It is written for a general audience and therefore technical details should be limited. More specifically, it presents a concise synopsis of the research topic, the main findings, and significance of the research. It should report the most important facts including recommendations for implementation. Readers who want further elaboration or support will refer to the text of the report. Since the summary may be the only portion of the report read, it is important that it contain, and in most cases be limited to, the following specific information:

• Research Issue (what is being investigated?)
• Results
• Conclusions (what is the significance of these findings?)
• Recommendations and Steps Needed for Implementation (if applicable)

While the length of the executive summary will vary depending on the subject matter, it should generally be no longer than two pages.

In a few cases, because of patent rights or length and complexity of the material, only an Executive Summary will be published. In this instance, the Summary will be longer and contain more detail. The decision to publish only an Executive Summary will be made jointly by the Technical Advisory Panel, ORA, the Principal Investigator, and other relevant DOT offices. Note that a decision to publish only an Executive Summary does not eliminate the author’s contractual requirement for submittal of a full report to Mn/DOT in publishable format.

INTRODUCTION

A tendency at times is for report writers to confuse the Introduction with the Executive Summary. This is understandable since some information presented in each of these two sections does in fact overlap. However, despite minor duplication of information, the Introduction and Executive Summary are distinct sections with different purposes and overall content.

The Introduction differs from the Executive Summary in that, while both discuss the research issue, the Introduction describes the research issue within the context of preparing the reader for what is to follow in the text of the report. It emphasizes the historical background of the research problem, what the research attempts to discover, and the basic scheme of the procedure or methods used. It also briefly describes the general organization of the report so that the reader knows what to expect. Unlike the Executive Summary, however, the Introduction does not focus on the research results, conclusions, and recommendations for implementation.

The most common points discussed in the introduction are:

• The purpose of the report (research objective).
- A description of the problem.
- The scope and limits of the report. This describes what is and is not covered in the report.
- A brief overview of the general organization of the report.

The Introduction will vary depending on the objectives stated in the work plan. In some cases the Introduction may mention previous research done in the report's topic field including the chief contributions of others.

The Introduction may be written as a separate section placed immediately before the report body or incorporated into the report body as the first chapter.

**REPORT BODY**

The organization and content of the report body will vary depending on the unique nature of the particular research project. The information to be included and organization of the report will be determined during the various TAP meetings and will usually follow the direction indicated in the work plan. However, in general, the report body will discuss the following:

- The background of the research problem.
- The research methods and approach.
- An analysis of the research results with its suggested conclusions.
- Recommendations for implementation and/or further testing.

Segment the report into chapters numbered sequentially beginning with arabic numeral 1. Subheadings may be distinguished either by numbered subsets (1.1, 1.2, etc.) or through font changes and indentions as used in this document. Limit the report contents to the information that is necessary to inform the reader on the research topic. Do not include extraneous or irrelevant data which does nothing to clarify the issue being addressed. Supporting detail information may be included as appendices.
REFERENCES
For citations of sources, use a reference format; do not use footnotes. Reference citations should be incorporated into the text consistent with the specific instructions detailed on page 19. See Appendix F for reference style. The reference list should include only references cited in the text, numbered in the order in which they are first cited.

APPENDIX(ES)
The Appendix section is presented at the end of the research report. For instructions regarding typography and style see page 20.
CHAPTER 3
VISUAL AND TYPOGRAPHICAL FEATURES

DOCUMENT FORMAT

Font
Use the font style CG Times or any similar font in a minimum 11 point size. The font style used in this document is CG Times, 12 point, which is recommended. Use the same font style for title pages, and vary the font size as shown in the example in Appendix G.

Line Spacing
The text lines within the report should be spaced at one and a half or two spaces between lines.

Margins
- Left and right margins on each page should be one inch to allow for options in binding.
- Top and bottom margins should also be one inch.
- Page numbers should be within the bottom one inch margin.
- Do not use decorative running heads, logos, or other advertising on text pages.

Dangling Lines
Avoid placing the last line of a paragraph by itself on a following page, particularly when it would fall on an otherwise blank page. Likewise, avoid positioning the first line of a paragraph alone on a preceding page. Solitary line placements are awkward for the reader and may disrupt concentration.

Abbreviations, Acronyms and Symbols
- Define abbreviations, acronyms and symbols the first time they are used in both the Executive Summary and the report text. Recall that the Executive Summary stands alone as a distinct element from the research
report, which is why it must also have acronyms, abbreviations and symbols defined.

- The definition or full title should be given first followed by the abbreviated term or symbol in parentheses (for example, "Federal Highway Administration (FHWA)."

- Subsequent appearances will be in the abbreviated format (for example, "FHWA").

PAGE NUMBERING

Page Order

Numbering the pages and placing the report sections in the correct order is critical for submittal to the printer. Errors in page numbering and order may create considerable delays in publishing. The typing job will be much easier and with fewer errors if the typist is aware of the page numbering system prior to typing. Correct formatting of the document in the beginning avoids problems with revisions later. If you have questions about page numbering, please clarify them before submitting final documents for printing. Also make note of the following:

- Page numbering in Arabic numerals commences with the Introduction and ends with the References.
- All page numbers should be centered at the bottom of each page within the one-inch margin.
- If a page within the Report Body contains only a table or figure, the page should be numbered as part of the report.
- Tables and figures listed in the Appendix will be numbered as part of the Appendix. (See page 20 for numbering Appendix pages.)

Un-numbered Pages

- All report pages prior to and including the Table of Contents do not have page numbers: this includes:
  - Technical Report Documentation Page
  - Title Page
- Acknowledgement Page
- Table of Contents.

- The Executive Summary follows the Table of Contents and may either be numbered in lower case roman numerals to distinguish it from the rest of the report or it may be left un-numbered.

Single-Sided Versus Double-Sided Pages

- For reports with ten pages or less, page printing will be one-sided.
- For reports with more than ten pages, page printing will be double-sided.
- When numbering pages for double-sided reports, think of the report in its finished state, as a book. The book begins with page 1 on a right-hand page. Page 2 is on a left-hand page, and so on. Therefore, all right-hand pages are odd numbered (beginning with page 1) and all left-hand pages are even numbered (beginning with page 2).

Right Page and Left Page Format
Beginning certain sections and chapters on right-hand pages makes it easier for a reader to locate a particular section when browsing through the report.

- The Technical Report Documentation page, Title Page and Acknowledgement Page are single pages appearing on right-hand pages. The Table of Contents begins on a right-hand page and continues on both left/right pages until ended.
- Each new chapter begins on a right-hand page with an odd page number. This rule holds even when the previous chapter ends on the prior right-hand page. To illustrate, if Chapter 1 ends on page 5 (a right-hand page), page 6 (the back of page 5 and therefore a left-hand page) will be left blank, and Chapter 2 will begin on page 7 (a right-hand page). Page 6 is left blank with no page number on it (the page number is understood, not printed). If, however, Chapter 1 ends on page 6, that
page will show page number 6 and Chapter 2 will still begin on page 7 (a right-hand page).

- Other sections that always begin on a right-hand page are:
  - Executive Summary
  - Table of Contents
  - References
  - Appendix (If more than one appendix, each appendix.)

Software Capability for Page Numbering

Some software programs only allow sequential page numbering that may cause difficulty for the typist in ensuring that each new chapter begins with an odd number. The following suggestions are offered as ways to overcome page numbering difficulties:

- Insert a blank page after the end of any chapter that ends with an odd-numbered page, or
- Type each chapter on a separate document.
CHAPTER 4

GRAPHICS

INTRODUCTION

The use of graphic elements in a research report adds interest and often provides a description that would be difficult with written words alone. Because of different methods available for reproducing research reports and various costs associated with them, it is recommended that authors contact the ORA when using graphic elements not covered in this chapter.

PHOTOS

- Either black and white or color prints may be submitted for publication, however, black and white prints will produce a clearer image when reproduced in black and white.
- If color reproductions are needed in the final report, contact the ORA for instructions. Color photos in a finished report add considerable cost and require advance arrangements for printing.
- In general, photos should be in a horizontal configuration with a standard size of 3-1/2" x 5" borderless.
- Photos may be reduced, enlarged, cropped or rotated, but this needs to be determined before the final copy is submitted for printing.
- Photos may be grouped all on one page or at the top or bottom of the page on which they are referenced. Printing costs will be less if photos are grouped on a page since cost is based on number of pages with photos rather than number of photos. Try to position the photos after their reference in the text rather than before. Such placement makes the report easier to comprehend.
- Captions should be brief (phrases, not sentences, and located directly below the photo).
• If photographs are being used within the report text, provide sufficient blank space at their locations to allow for placement by the printer. A minimum 1/2 inch margin is needed at the top, each side and below the caption of each photo. Refer to page 23 for information on submitting photos with original (camera-ready) copy.

MAPS, TABLES AND FIGURES
The presentation of maps, tables, and figures may provide meaningful support to a report's content. To maximize the effectiveness of the visual elements, it is important that a map, table, or figure:

• Is relevant and necessary to support the research point being discussed.
• Supplements rather than duplicates information given in the text.

Visual Clarity
A map, table or figure that does not reproduce clearly may be difficult to read, thereby detracting from its purpose to support the author’s findings. Observe the following points:

• If possible, submit visual items in original form, whether the original material is scanned or designed into the text, or submitted separately to be incorporated into the text at the printer. Original material ensures the highest visual quality.
• Photocopies are less desirable than original items, yet are acceptable if they are of high quality.
• Do not use color unless authorized by ORA. Instead use screens, cross-hatching, pattern lines, reverses, dots, or other similar techniques which may be substitutes for color.
• Shades of gray may be reproduced if no more than one shade is used between black and white.
• Computer printouts from dot matrix printers are usually not of sufficient quality for reprinting. However, if it's necessary to use dot-matrix
printed material, verify quality with ORA staff before submitting it for printing. It may be necessary to re-type the data for printing.

- Avoid the use of oversize illustrations that must be folded unless first obtaining approval from ORA. Most large illustrations may be planned to spread across facing pages.
- Keep type size to 10 point or larger to ensure legibility of a map, table, or figure.

**Labeling**

Appropriate labeling is essential and should be done in accordance with the following:

- All maps, tables, and figures should have captions that briefly identify them, without providing any background or describing results.
- Number the maps, tables, and figures separately and consecutively in the order they are first cited in the text using Arabic numerals. The numbers should be in a two-number decimal format as in "1.1," where the first number reflects the chapter in which the map, table, or figure is located, and the second number represents the numerical order of presentation for that particular visual element. For example, "Figure 2.3" means the third figure in chapter 2. Chapters that feature both tables and figures, some of the tables and figures will have identical numbers. For example, Table 3.1 and Figure 3.1 would both be in chapter 3.
- If a report only has one chapter, omit the suffix "1"; in this case a simple sequential order such as Figure 1, Figure 2, etc. is adequate.

**Placement**

There are three options for the placement of maps, tables and figures depending on the nature of the report and author preference:
• Immediately after its reference in the text. This option usually makes the report easier to comprehend by placing the visual item in close proximity to its associated discussion points, rather than in a separate section.
• At the end of a chapter for those visual items corresponding to that chapter.
• In an appendix section which would include all of the report’s maps, tables, and figures.

The last two options are less desirable for ease in reading the report unless the report is 10 pages or less.

**Landscape Positioning**

There are additional considerations for maps, tables, and figures that occupy an entire page lengthwise or "landscape." (See Appendix H for examples.) Note on the examples that the correct placement of the landscape page varies depending upon whether the page is placed on the left or right side of the report. Specifically, note that:

• To place a landscape page on the left side of the report, place the page with the lower edge of the page to be positioned into the report binding.
• If the landscape page is placed on the right side of the report, it should be placed with the top edge of the landscape page to be positioned into the report binding.

In either case, a reader of the report would have to rotate the report clockwise in order to read the landscape table or figure in an upright position.
CHAPTER 5
SUPPORTING MATERIAL

REFERENCES

- References are noted within the text of the research report and listed in the reference list at the end of the report.
- Do not use footnotes.
- Denote a reference in the text by placing an arabic numeral in parentheses or brackets at the appropriate place in the text (e.g., (2) or [2]).
- List the references in the Reference List by number in the order in which they first appear in the text.
- Include only those references in the Reference List which are cited in the report.
- If a reference is cited more than once in the report, continue to use the same number first assigned to the reference.
- Do not list unpublished material, telephone conversations, or other personal communication in the reference list, although they may be cited within the text. Note such sources in the text within parentheses or brackets stating the author's name and a phrase such as "unpublished data" or "telephone conversation." Another useful alternative is to cite the source within the text wording, for example stating "According to ..." or "Robert Barns, President of XYZ Company, reports that...."
- Be sure that references in the reference list are complete including names of corporate or personal authors or editors; title of article, chapter, book, or report; publisher or issuing agency; location of publisher and year of publication; volume and issue or report number; and page numbers in bibliographic style.
APPENDIX(ES)

- Number pages of the Appendix separately from the rest of the report using an alpha-numeric system.
- Begin each Appendix with a title sheet (which is not numbered) stating the Appendix letter (A, B, C, etc.) and the title of the Appendix. Use the same font styles and sizes used in the report title page.
- Use the same font sizes and style as those used for the report title page.
- Number Appendix pages with their corresponding letter, a dash and sequential numbers. Pages of the first appendix (A) will be numbered A-1, A-2, etc. Pages of the next appendix will be numbered B-1, B-2, and so on. The right hand/odd number, left hand/even number format applies to Appendix pages also.

METRICATION

Beginning with the distribution of these guidelines, Mn/DOT reports will give metric units of measurement with English units in parentheses. By 1996 all Mn/DOT reports will include metric units of measurement, rounding to even metric rather than even English units. Reports may always provide English units in parentheses especially if the intended audience is the general public. See Appendix I for Procedural Rules.
CHAPTER 6

SUBMITTAL OF THE RESEARCH REPORT

REPORT APPROVAL PROCESS: TECHNICAL AND EDITORIAL REVIEW

The research report must be approved by the Minnesota Department of Transportation (Mn/DOT) before being accepted for printing. Preparation for acceptance, publication and distribution will begin no later than the final meeting of the Technical Advisory Panel (TAP), at which time the approval process will be discussed.

The approval process requires both technical and editorial reviews. The technical reviews are done by members of the TAP who have been involved in the research project. TAP members review the report in detail to ensure that the written material accurately reflects and clearly documents the research that was done. The editorial review, done by an Office of Research Administration (ORA) editor, ensures that the report is consistent with Mn/DOT publication guidelines.

The author is responsible for basic proofreading prior to submittal of the report for review. The editorial reviewer will spot check for spelling and grammar, and if a substantial number of errors are found, the report will be returned to the author for re-submittal.

All reports sent to Mn/DOT should be accompanied by a memo or cover letter which references the report title and contract/agreement number(s). University of Minnesota authors should forward a copy of the cover memo (without the report) to the Research Coordinator at the Center for Transportation Studies.

The number of draft copies required depends on the following circumstances.
If a TAP was established:

- Submit one draft copy for each TAP member to the Technical Liaison (TL). The TL coordinates the technical reviews and integrates comments onto a master draft which is returned to the author.
- Submit two draft copies to the ORA Project Representative for editorial review. Editorial comments will be sent directly to the author by the ORA reviewer.

If no TAP was established:

- Submit two draft copies to the ORA Research Services Engineer who will arrange for editorial comments by the reviewer, who will send them directly to the author.

If report is authored at the Minnesota Road Research Office:

- The technical content of the report should be reviewed by technical experts of the author’s choice.
- Send one draft copy to the ORA Technology Transfer Manager for editorial comments. Comments will be sent directly to the author by the reviewer.

Regardless of the circumstances outlined above, the initial report review by Mn/DOT generally takes three weeks. The author should contact the TL or the ORA editor as necessary to discuss reviewers’ comments and make appropriate revisions until the report is completed. In most cases, revisions by the author should take no longer than three weeks. If a delay occurs, the author should notify the Research Services Engineer of the approximate date of completion.
SUBMISSION OF MATERIALS FOR PUBLICATION

Once the report has gone through both the technical and editorial review process, and all revisions have been made, it is ready to be submitted for printing. Submit the final report with a cover letter stating the author’s action on all comments given by the reviewers. On a separate page, include the information for the Technical Report Documentation (TRD) Page or the completed TRD Page on disk (see instructions for the Technical Report Documentation Page in Appendix B).

The report should be submitted in two different forms, the Original (Camera-Ready) Copy and the Sample Copy, described as follows:

Original (Camera-Ready) Copy

The original (camera-ready) copy of the report is the actual copy used in the printing process. It is important that each page be clean and free of wrinkles or other visual flaws. This copy should not be bound, stapled, or hole-punched. Do not use tape, liquid paper, or paste on the original copies. If incorporating graphs or charts from other sources into your document, treat them the same as you would photos (see page 15). Each page should be printed on only one sheet of paper, even though the final report may be double-sided. Ensure that the pages are in the correct order. Clearly identify this copy as the "Original" to be used in the printing process. The cover design and original artwork should be forwarded with the original copy of the report.

Photographs should be supplied with the camera-ready copy in a separate envelope. Placement of photos should be indicated in outline directly on the original copy in a non-photo blue pencil. Label photo locations by number or letter on both the page of the original (in non-photo blue pencil) and back of the photo.

Sample Copy

The sample copy is used as a guide in setting up the printing equipment and binding the final report. As such, it is important that the sample copy exactly duplicate the desired form and organization of the published report. However, the sample copy should not be bound in a way that it cannot be disassembled in case any last minute changes are necessary; the sample copy
should simply be clipped together with a large binder clip when sent to ORA. The ORA will bind the sample copy to be sent to the printer.

The sample copy should contain all pages to be included in the final report in the correct order that they will appear in the finished report, including both front and back cover. If the pages in the final report are double-sided, the pages in the sample copy should also be double-sided. Photocopies of photos should be placed in the sample copy in their precise location in the correct size, whether enlarged or reduced in size. The pages of the sample copy do not have to be camera-ready, but can be photocopies. This form of the report should be identified as the "Sample Copy."

**Computer Disk**

If possible, please submit a copy of the report on computer disk in either WordPerfect or Microsoft Word for IBM or MacIntosh along with the original and sample copies.

In addition, the disk containing the completed Technical Report Documentation Page should also be sent if that form was completed by the author.

> Please send the original copy and sample copy in a protective covering such as cardboard or other durable material to protect them from damage during mailing.

Send the original and sample copies to the ORA Research Services Engineer who will forward them to the Technology Transfer Manager who coordinates publication. (Office of Minnesota Road Research authors should send them directly to the Technology Transfer Manager.) When the copies are sent, the author should again identify the contract or agreement number of the study so that ORA can easily locate the appropriate files.

**PUBLICATION AND DISTRIBUTION**

Mn/DOT, the TAP, and the Principal Investigator will jointly determine the parties to whom the reports will be distributed. A "Mn/DOT Report Distribution List" is available from the Office
of Research Administration (phone: 612-282-2274) to facilitate the selection. Desired recipients of the published report should be checked off or otherwise indicated on the distribution list. Mn/DOT will coordinate the mailing of the research reports to those parties indicated for distribution. The Principal Investigator will be notified when publication has been completed when he or she receives five copies (or more if desired) of the final report in the mail.
APPENDIX A

EXAMPLES OF FUNDING SOURCE
ACKNOWLEDGEMENTS
EXAMPLE 1

Funding Acknowledgement

This project was conducted with funding provided by the Center for Transportation Studies (CTS). The CTS supports the University of Minnesota’s research mission with a broad program covering many topics related to transportation. The program includes both fundamental and applied research, with the goal of expanding the existing body of transportation knowledge.

This project was conducted with funding provided by the Minnesota Local Road Research Board (LRRB). The LRRB’s purpose is to develop and manage a program of research for county and municipal state aid road improvements. Funding for LRRB research projects comes from a designated fund equivalent to 1/2 of one percent of the annual state aid for county and city roads.

EXAMPLE 2

Funding Acknowledgement

This project was made possible with support from the Minnesota Guidestar Office. Minnesota Guidestar’s mission is to provide leadership and coordination for an Intelligent Transportation Systems (ITS) program that provides the greatest benefits to travelers in Minnesota.
INSTRUCTIONS TO COMPLETE THE TECHNICAL REPORT DOCUMENTATION PAGE (TRD)

There are two ways in which the TRD Page can be completed: 1) the author may complete the form by requesting ORA to provide a blank version of this form in either MacIntosh or IBM, Wordperfect format, or 2) ORA will complete the form using certain information provided by the author. In the first case where the author receives the blank form on disk, the author should complete the following item numbers on the form:

4, 5, 7, 9, 11 (if applicable), 12, 13, 16, 17

All other item numbers should be left blank to be completed by ORA where necessary.

If preferred, ORA will complete the TRD form to be included in the published report. In that case the author needs to provide ORA with information for the following items on a separate sheet of paper:

4, 5, 7, 9, 13, 16, 17

Instructions for all items mentioned above are as follows:

**Item 4 - Title and Subtitle:** The title should be the same as the report. Use all capital letters for the title. When a report is prepared in more than one volume, this block should show the main title plus the volume number and the subtitle for the volume being reported.

**Item 5 - Report Date:** Indicate the month and year of the date shown on the report.

**Item 7 - Author(s):** Give name(s) as listed on the Title Page.

**Item 9 - Performing Organization Report No.:** Give the name and address, including zip code, of the organization who was responsible for the research and preparation of the report. This should be the same as the name and address appearing on the Title Page.

**Item 11 - Contract or Grant No.:** Insert the contract or agreement number.

**Item 12 - Sponsoring Agency Name and Address:** Indicate "Minnesota Department of Transportation, 395 John Ireland Boulevard, St. Paul, MN 55155."

**Item 13 - Type of Report and Period Covered:** State either interim report, final, etc. For interim reports, indicate the time period covered.

**Item 16 - Abstract:** This is a brief (200 words or less) factual summary of the most significant information contained in the report. An abstract should state the purpose,
methods, results, and conclusions of the work effort. For the purpose, include a statement of goals (objectives, aims). For methods, include experimental techniques or the means by which the results were obtained. Results (findings) are the most important part of the abstract and selection should be based on one, or several of the following: new and verified events, findings of permanent value, significant findings that contradict previous theories, or findings that the author knows are relevant to a practical problem. Conclusions should deal with the implications of the findings and how they tie in with studies in related fields. Do not repeat the title or other items provided on this page. When a report consists of a number of volumes, include the title of each of the other volumes in each abstract. If the report contains a significant bibliography or literature survey, mention it also.

Reports presenting the results of computerized model development will use the following structure for the preparation of abstracts:

- Technical Model description (nature of the model or simulator)
- Areas of model application
- Special model requirements
  - Areas of model application
  - Other special considerations

**Item 17 - Document Analysis/Descriptors:** This is a listing of the terms (keywords) that identify the major concept of the research. *It is especially important to identify key words and phrases that may not appear in the report title or abstract, so as to more broadly encompass the entire research area. This will expand the field of possible terms for literature searches so that researchers can broadly identify all research sources related to their topic area.* Supplying keywords is particularly important for libraries that do not have the capability to search several different data fields, but must rely on keywords used as index entries for cataloging. For this reason, it is important to select specific and precise terms or short phrases that identify the principal subjects covered in the report.
Technical Report Documentation Page

1. Report No. | 2. | 3. Recipient's Accession No.

4. Title and Subtitle

5. Report Date

6.

7. Author(s)


9. Performing Organization Name and Address

10. Project/Task/WorkUnit No.

11. Contract(C) or Grant(G) No.

12. Sponsoring Organization Name and Address

13. Type of Report and Period Covered


15. Supplementary Notes

16. Abstract (Limit: 200 words)

17. Document Analysis/Descriptors

18. Availability Statement

No restrictions. This document is available through the National Technical Information Services, Springfield, Va.

Unclassified | Unclassified | | |
This report presents the results of a one-year study on large-stone asphalt mixtures (LSAM). A thorough review of the existing technology regarding materials, mix design, and performance is included. This study expanded upon the body of knowledge by exploring an easier means of mixture design and explaining the fundamental properties of large-stone mixtures with respect to the aggregate gradation.

It was found that a dense LSAM gradation possesses better strength and durability properties than a more open LSAM gradation. Furthermore, a mix design methodology is presented wherein the optimum asphalt content for the mixture may be determined on the basis of aggregate and compacted sample properties. This eliminates the need for cumbersome Marshall stability and flow measurements. The frequency dependency of large-stone mixtures is more pronounced at low temperatures than that of a conventional mixture. The tendency for thermal cracking should be lower for a LSAM than for a conventional mixture.

Finally, recommendations are made to develop a permissive specification for LSAM, and to adopt the volumetric mixture design procedure outlined in the report.
Example of a Completed Technical Report Documentation Page

Technical Report Documentation Page

MN/RC - 94/09.  

2.  

3. Recipient's Accession No.  

4. Title and Subtitle  
INVESTIGATION OF LARGE-STONE MIXTURES  

5. Report Date  
December 1993  

6.  

7. Author(s)  
David E. Newcomb, Zhang Wei, Mary Stroup-Gardiner  


9. Performing Organization Name and Address  
Civil Engineering Department  
University of Minnesota  
500 Pillsbury Dr. SE  
Minneapolis, Mn 55455  

10. Project/Task/Work Unit No.  

11. Contract(C) or Grant(G) No.  
(C) Mn/DOT 68893 TOC 76  

12. Sponsoring Organization Name and Address  
Minnesota Department of Transportation  
395 John Ireland Boulevard  
St. Paul, Mn. 55155  

13. Type of Report and Period Covered  
Final Report  
1992-1993  


15. Supplementary Notes  

16. Abstract (Limit: 200 words)  
This report presents the results of a one-year study on large-stone asphalt mixtures (LSAM). A thorough review of the existing technology regarding materials, mix design, and performance is included. This study expanded upon the body of knowledge by exploring an easier means of mixture design and explaining the fundamental properties of large-stone mixtures with respect to the aggregate gradation.  

It was found that a dense LSAM gradation possesses better strength and durability properties than a more open LSAM gradation. Furthermore, a mix design methodology is presented wherein the optimum asphalt content for the mixture may be determined on the basis of aggregate and compacted sample properties. This eliminates the need for cumbersome Marshall stability and flow measurements. The frequency dependency of large-stone mixtures is more pronounced at low temperatures than that of a conventional mixture. The tendency for thermal cracking should be lower for a LSAM than for a conventional mixture.  

Finally, recommendations are made to develop a permissive specification for LSAM, and to adopt the volumetric mixture design procedure outlined in the report.  

17. Document Analysis/Descriptors  
Large-Stone Asphalt Mixtures  
Asphalt Mix Design  
Asphalt Mixture Gradation  

18. Availability Statement  
No restrictions. This document is available through the National Technical Information Services, Springfield, Va. 22161  

19. Security Class (this report)  
Unclassified  

20. Security Class (this page)  
Unclassified  

21. No. of Pages  
96  

22. Price  

B-5
APPENDIX C

EXAMPLES OF TITLE PAGES USING VARIOUS DISCLAIMERS
CULTURE AND RE-INTRODUCTION OF VESICULAR ARBUSCULAR MYCORRHIZAE IN A PRAIRIE RESTORATION

Final Report

Prepared by

Dwayne L. Stenlund, MS
Department of Plant Biology
University of Minnesota

Robert L. Jacobson, MS
Office of Environmental Services
Minnesota Department of Transportation

Iris D. Charvat, PhD
Department of Plant Biology
University of Minnesota

August 1994

Published by

Minnesota Department of Transportation
Office of Research Administration
200 Ford Building  Mail Stop 330
117 University Avenue
St Paul  Minnesota  55155

This report represents the results of research conducted by the authors and does not necessarily represent the views or policy of the Minnesota Department of Transportation. This report does not contain a standard or specified technique.
Waste Products in Highway Construction

Final Report

Prepared by
Chunhua Han, Ph.D.
Braun Intertec Pavement, Inc.
1983 Sloan Place
St Paul MN 55117

April 1993

Prepared for the
Minnesota Local Road Research Board
Office of Research Administration
200 Ford Building Mail Stop 330
117 University Avenue
St Paul Minnesota 55155

The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Minnesota Local Road Research Board or the Minnesota Department of Transportation.
A Traffic Data Management System for Navigation, Collision Detection, and Incident Detection

Final Report

Prepared by

Shashi Shekhar
Computer Science Department
University of Minnesota
Minneapolis MN 55455

Peter A. Hancock
Human Factors Research Laboratory
University of Minnesota
Minneapolis MN 55455

May 1994

Published by

Minnesota Department of Transportation
Office of Research Administration
200 Ford Building Mail Stop 330
117 University Avenue
St Paul Minnesota 55155

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policies of the Minnesota Department of Transportation at the time of publication. This report does not constitute a standard, specification, or regulation.

The authors and the Minnesota Department of Transportation do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to this report.
APPENDIX D

EXAMPLES OF ACKNOWLEDGEMENTS
ACKNOWLEDGEMENT

The authors express appreciation to the Office of Maintenance and the Materials and Research Laboratory of the Minnesota Department of Transportation for support of this research, and are indebted to Dr. O.S. Kwon of the 3M Company, Minnesota, for donation of hydrogel, as well as to Dean Kourtjan of the North Star Steel Co., Minnesota, for spectrographic analysis of rebar steels.

ACKNOWLEDGEMENTS

The fabrications and procedures presented in this report were developed in conjunction with Shannon & Wilson, Inc., Geotechnical Consultants, St. Louis, Missouri. The authors would also very much like to thank the following individuals and organizations for their contributions to this document.

Ron Atkins - Instrumentation/Electrical Consultant
Dave Newcomb - Department of Civil Engineering, University of Minnesota
Carl Lenngren - Department of Civil Engineering, University of Minnesota
Alberta Research Council
Monica Penshorn - Physical Research Section, Minnesota Department of Transportation
Carol Isberg - Mn/ROAD
Office of Research Administration, Minnesota Department of Transportation

ACKNOWLEDGEMENTS

The financial and logistical support provided by the Local Road Research Board, the Minnesota Department of Transportation, the Center for Transportation Studies at the University of Minnesota, Wheeler Consolidated, Inc. and Sibley County for this work is gratefully acknowledged.

Acknowledgements

The author would like to acknowledge the help of several people whose work was instrumental to the completion of this study.

1. Kevin Kosobud, Mn/DOT Assistant Concrete Engineer.
2. Mn/DOT District 7B, Windom, Maintenance Personnel
3. Steve Oakey, Mn/DOT District 7, Mankato, Materials Engineer
4. Duane Pingeon, Mn/DOT District 7B Maintenance Superintendent
APPENDIX E

EXAMPLE OF TABLE OF CONTENTS
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER 1</th>
<th>INTRODUCTION</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Background</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Objective</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Report Organization</td>
<td>3</td>
</tr>
<tr>
<td>CHAPTER 2</td>
<td>LITERATURE REVIEW</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Types of LSAM Gradations</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Mix Design Practices</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
<td>17</td>
</tr>
<tr>
<td>CHAPTER 3</td>
<td>EXPERIMENTAL DESIGN AND MATERIALS</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Experimental Design</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Materials</td>
<td>30</td>
</tr>
<tr>
<td>CHAPTER 4</td>
<td>MIX DESIGNS</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Marshall Mix Design</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Volumetric Mix Design</td>
<td>49</td>
</tr>
<tr>
<td>CHAPTER 5</td>
<td>CONCLUSIONS AND RECOMMENDATIONS</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Conclusions</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Recommendations</td>
<td>60</td>
</tr>
<tr>
<td>REFERENCES</td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.1</td>
<td>Material Properties Affected By Asphalt Grade</td>
<td>9</td>
</tr>
<tr>
<td>Table 2.2</td>
<td>Acceptable Criteria for LSAM (Ken DOH)</td>
<td>12</td>
</tr>
<tr>
<td>Table 2.3</td>
<td>Penn DOT LSAM Gradation Band</td>
<td>14</td>
</tr>
</tbody>
</table>

## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 2.1</td>
<td>Types of Large Stone Asphalt Mix</td>
<td>7</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>Aggregate Gradations</td>
<td>22</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>Results of Marshall Mix Design</td>
<td>35</td>
</tr>
</tbody>
</table>
APPENDIX F

EXAMPLES OF REFERENCES
REFERENCES


APPENDIX G

EXAMPLES OF FONT SIZES AND STYLE
Example is CG Times

10 pt.  ABCDEFGHIJKLMNOPQRSTUVWXYZ  
        abcdefghijklmnopqrstuvwxyz1234567890

11 pt.  ABCDEFGHIJKLMNOPQRSTUVWXYZ  
        abcdefghijklmnopqrstuvwxyz1234567890

Normal 12 pt.  ABCDEFGHIJKLMNOPQRSTUVWXYZ  
        abcdefghijklmnopqrstuvwxyz1234567890

18 pt.  ABCDEFGHIJKLMNOPQRSTUVWXYZ  
        abcdefghijklmnopqrstuvwxyz1234567890

24 pt.  ABCDEFGHIJKLMNOPQRSTUVWXYZ  
        abcdefghijklmnopqrstuvwxyz1234567890
APPENDIX H

EXAMPLES OF LANDSCAPE PAGE POSITIONING
# RESEARCH REPORT STATUS

<table>
<thead>
<tr>
<th>Status</th>
<th>Rpt. No.</th>
<th>ARTS # Contract #</th>
<th>Agency</th>
<th>Report Title</th>
<th>Authors</th>
<th>P.I./ Funding Source(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>None</td>
<td>93-058R 69325 TOC #86</td>
<td>U of M</td>
<td>Transportation and Economic Development in the Upper Midwest: New Models for Federal, State, and Local Cooperation in Infrastructure Investment</td>
<td>Schuh</td>
<td></td>
<td>Report was printed &amp; distributed to members of Steering Comm. &amp; Research Advisory Comm. by the Humphrey Inst. Mn/DOT forwarded copies to mandatory recipients. Dist. 6/94</td>
</tr>
</tbody>
</table>

1 - Draft Received  
2 - Out for Comments  
3 - Camera Copy Received  
4 - Waiting for Revisions or art work  
5 - Order being Processed  
6 - At Printer  
7 - Received from Printer  
8 - Distributed
<table>
<thead>
<tr>
<th>Status</th>
<th>Rpt. No.</th>
<th>ARTS # Contract #</th>
<th>Agency</th>
<th>Report Title</th>
<th>Authors</th>
<th>P.I./Funding Source(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>94-02</td>
<td>93-036R 68816 TOC #70</td>
<td>U of M</td>
<td>Commuter Linkages Among Counties in the St. Cloud-Twin Cities-Rochester Settlement Field</td>
<td>Adams</td>
<td></td>
<td>Distributed 4/94</td>
</tr>
<tr>
<td>8</td>
<td>94-03</td>
<td>93-062R 69777 TOC #90</td>
<td>U of M</td>
<td>Evaluation of the E-TRAN Vehicle Propulsion Concept</td>
<td>Hennessey Donath</td>
<td></td>
<td>Distributed 4/94</td>
</tr>
<tr>
<td>8</td>
<td>94-04</td>
<td>93-017R 67411 TOC #57</td>
<td>U of M</td>
<td>Development of Design Guidelines for Use of Shredded Tires as a Light Weight Fill in Road Subgrade and Retaining Walls</td>
<td>Drescher Newcomb</td>
<td></td>
<td>Distributed 5/94</td>
</tr>
<tr>
<td>8</td>
<td>94-05</td>
<td>93-074R 70340 TOC #99</td>
<td>U of M</td>
<td>Institutional Barriers to the Adoption of Electronic Data Collection and Interchange as it Relates to Commercial Vehicles</td>
<td>Beier</td>
<td></td>
<td>Distributed 3/94</td>
</tr>
<tr>
<td>8</td>
<td>94-06</td>
<td>93-008R 66531 TOC #47</td>
<td>U of M</td>
<td>Geostatistics for Subgrade Characterization</td>
<td>Barnes</td>
<td></td>
<td>Distributed 5/94</td>
</tr>
</tbody>
</table>

1 - Draft Received  2 - Out for Comments  3 - Camera Copy Received  4 - Waiting for Revisions or art work  5 - Order being Processed  6 - At Printer  7 - Received from Printer  8 - Distributed
<table>
<thead>
<tr>
<th>Status</th>
<th>Rpt. No.</th>
<th>ARTS # Contract #</th>
<th>Agency</th>
<th>Report Title</th>
<th>Authors</th>
<th>P.I./ Funding Source(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>94-07</td>
<td>94-002P</td>
<td>Phy Res</td>
<td>Field Performance of High Molecular Weight Methacrylate Monomers and Silanes on a D-cracked, Jointed Reinforced Concrete Pavement</td>
<td>Engstrom</td>
<td></td>
<td>Distributed 6/94</td>
</tr>
<tr>
<td>8</td>
<td>94-08</td>
<td>93-048R 69075 TOC #81</td>
<td>U of M</td>
<td>Polymerized Crumb Rubber Modified Mixtures in Minnesota</td>
<td>Newcomb Stroup-Gardiner Kim, Allen Wattenhoffer Spry</td>
<td></td>
<td>Distributed 8/94</td>
</tr>
<tr>
<td>8</td>
<td>94-09</td>
<td>93-042R 68893 TOC #76</td>
<td>U of M</td>
<td>Investigation of Large Stone Mixtures</td>
<td>Newcomb</td>
<td></td>
<td>Distrib. 5/94</td>
</tr>
<tr>
<td>8</td>
<td>94-11</td>
<td>93-041R 68882 TOC #75</td>
<td>U of M</td>
<td>Screening and Selection of Salt Tolerance in Native Warm Season Grasses</td>
<td>Biesboer/Jacobson</td>
<td></td>
<td>Distributed 8/94.</td>
</tr>
</tbody>
</table>

1 - Draft Received  
2 - Out for Comments  
3 - Camera Copy Received  
4 - Waiting for Revisions or art work  
5 - Order being Processed  
6 - At Printer  
7 - Received from Printer  
8 - Distributed
APPENDIX I

RULES FOR WRITING METRIC SYMBOLS AND NAMES
RULES FOR WRITING METRIC SYMBOLS AND NAMES

• Print unit symbols in upright type and in lower case except for liter (L) or unless the unit name is derived from a proper name.

• Print unit names in lower case, even those derived from a proper name.

• Print decimal prefixes in lower case for magnitudes $10^3$ and lower (that is, k, m, μ, and n) and print the prefixes in upper case for magnitudes $10^6$ and higher (that is, M and G).

• Leave a space between a numeral and a symbol (write 45 kg or 37 °C, not 45kg or 37°C or 37° C).

• Do not use a degree mark (°) with kelvin temperature (write K, not °K).

• Do not leave a space between a unit symbol and its decimal prefix (write kg, not k g).

• Do not use the plural of unit symbols (write 45 kg, not 45 kgs), but do use the plural of written unit names (several kilograms).

• For technical writing, use symbols in conjunction with numerals (the area is 10 m²); write out unit names if numerals are not used (carpet is measured in square meters). Numerals may be combined with written unit names in nontechnical writing (10 meters).

• Indicate the product of two or more units in symbolic form by using a dot positioned above the line (kg•m•s⁻²).

• Do not mix names and symbols (write N•m or newton meter, not N•meter or newton m).

• Do not use a period after a symbol (write "12 g", not "12 g.") except when it occurs at the end of a sentence.

Rules for Writing Numbers

• Always use decimals, not fractions (write 0.75 g, not $\frac{3}{4}$ g).

• Use a zero before the decimal marker for values less than one (write 0.45 g, not .45 g).

• Use spaces instead of commas to separate blocks of three digits for any number over four digits (write 45 138 kg or 0.004 46 kg or 4371 kg). Note that this does not apply to the expression of amounts of money.

• In the United States, the decimal marker is a period; in other countries a comma usually is used.
Conversion and Rounding

- When converting numbers from inch-pounds to metric, round the metric value to the same number of digits as there were in the inch-pound number (11 miles at 1.609 km/mi equals 17.699 km, which rounds to 18 km).

- Convert mixed inch-pound units (feet and inches, pounds and ounces) to the smaller inch-pound unit before converting to metric and rounding (10 feet, 3 inches = 123 inches; 123 inches x 25.4 mm = 3124.2 mm; round to 3124 mm).

- In a "soft" conversion, an inch-pound measurement is mathematically converted to its exact (or nearly exact) metric equivalent. With "hard" conversion, a new rounded, rationalized metric number is created that is convenient to work with and remember.

Visualizing Metric

A few basic comparisons are worth remembering to help visualize metric:

- One millimeter is about 1/25 inch or slightly less than the thickness of a dime.
  One meter is the length of a yardstick plus about 3-1/3 inches.
  One gram is about the mass (weight) of a large paper clip.
  One kilogram is about the mass (weight) of a softbound model building code book (2.2 pounds).
  One liter is about the volume of a 4 inch cube (100 mm x 100 mm x 100 mm). One liter of water has a mass of 1 kilogram.

- One inch is just a fraction (1/64 inch) longer than 25 mm (1 inch = 25.4 mm; 25 mm = 63/64 inch).
  Four inches are about 1/16 inch longer than 100 mm (4 inches = 101.6 mm; 100 mm = 3-15/16 inches).
  One foot is about 3/16 inch longer than 300 mm (12 inches = 304.8 mm; 300 mm = 11-13/16 inches).
  Four feet are about 3/4 inch longer than 1200 mm (4 feet = 1219.2 mm; 1200 mm = 3 feet, 11 1/4 inches).

- The metric equivalent of a typical 2-foot by 4-foot ceiling grid is 600 x 1200 mm, so metric ceiling tiles and lighting fixtures are about 3/8 inch smaller in one dimension and 3/4 inch smaller in the other.

- Similarly, the metric equivalent of a 4 by 8 sheet of plywood or drywall is 1200 x 2400 mm, so metric sheets are about 3/4 inch narrower and 1 -1/2 inches shorter.

- "Rounding down" from multiples of 4 inches to multiples of 100 mm makes dimensions exactly 1.6 percent smaller and areas about 3.2 percent smaller. About 3/16 inch is lost in every linear foot.
References

The metric units in this guide are those adopted by the U.S. government (see the Federal Register of December 20, 1990; Federal Standard 376A, Preferred Metric Units for Use by the Federal Government; and PB 89-226922, Metric Handbook for Federal Officials). They are identical to the units in the following publications, which constitute the standard reference works on metric in the United States:

- ASTM E 621, Standard Practice for Use of Metric (SI) Units in Design and Construction,
- ANSI/IEEE 268, American National Standard Metric Practice, and

For editorial matters, also refer to:

- American National Metric Council, Metric Editorial Guide and
- U.S. Metric Association, Metric Units of Measure and Style Guide.

See the "Metric References" section of this guide for ordering information.