**General Guideline for CM Master Research**

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*Note: to open web links in this WORD document, please Ctrl + Click*

# Master Research Procedure Overview

Research is substantial and creative work undertaken on a systematic basis in order to expand our knowledge base and improve industry practices. To that end, a master project or thesis research involves a major effort spanning three stages in three semesters, as show in Figure 1. This procedure engages students in research earlier in their graduate study and positions them for a successful master research.

1. **Proposal stage (CNST6100 spring/fall semester)**: Research Advisor assignment, student proposal development, and proposal review and approval by the CM faculty.
2. **1st semester research (CNST6396/6399 spring/fall semester)**: Students with a passing proposal proceed to the 1st semester research work.
3. **2nd semester research (CNST6396/6399 spring/fall semester)**: Students with satisfactory progress during the 1st semester proceed to the 2nd semester research.

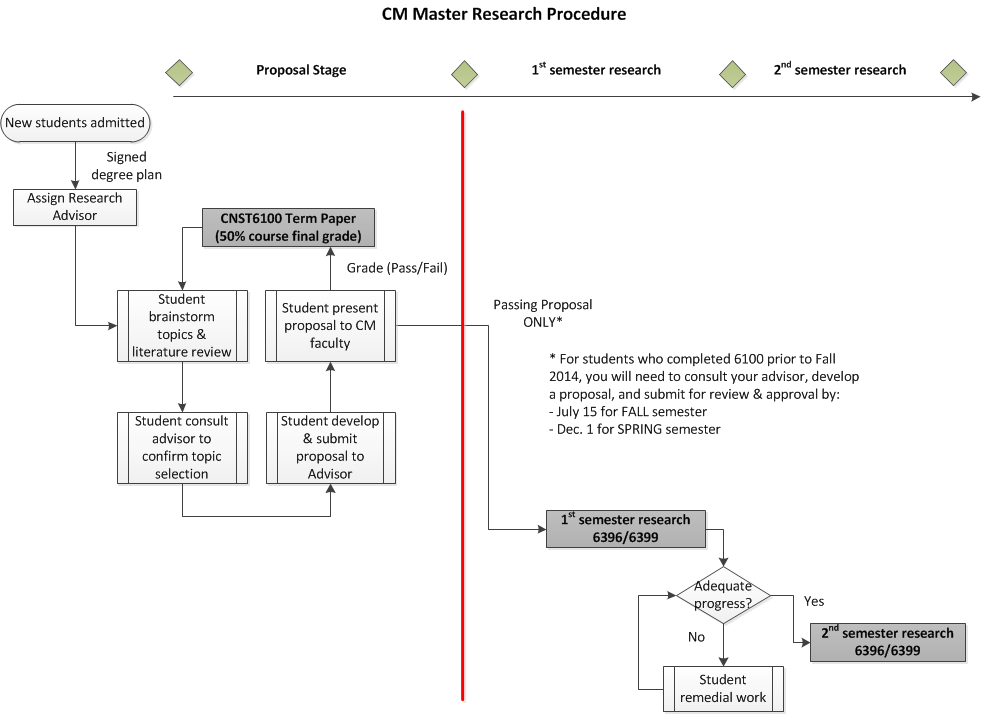


Figure 1. Master research procedure

# Proposal Stage

## 2.1 Research Advisor

When students start their CM master program, a CM faculty member will be assigned to a student as his/her Research Advisor. The Research Advisor will advise the student on topic selection, proposal review, and approval during the proposal stage (CNST6100 spring/fall semester); and later research course registration (CNST6396/6399 spring/fall semester), supervise and evaluate your research implementation and reporting during the 1st and 2nd semester research.

## 2.2 Proposal Development/CNST6100 Term Paper

CNST6100 CM Seminar introduces research in construction management, research planning, topic selection, proposal development, and technical writing. As a critical component of this course, students are required to develop their master research proposal for review and approval by the CM faculty. This proposal is considered as the CNST6100 term paper, which accounts for 50% of the final course grade. The proposal procedure is:

1. Student selects a research topic in consultation with the Research Advisor. There are two options of identifying a research topic: (a) You are encouraged to identify a topic based on your particular interests in CM, your industry experience, and future career goal; or (b) select a pre-defined topic, e.g. request for proposals from CII, DOT, etc. or your Research Advisor’s active research topics, if available. As an example, [click here to see sample research problems identified by different](http://www.uh.edu/~lsong5/documents/Sample_problems.pdf) industry organizations. In all cases, students should determine their research interests, conduct a preliminary search for potential research topics, and discuss with as many individuals as possible to gain a broad perspective of the research topic. Once potential topic(s) is determined, students should consult with the Research Advisor to get suggestions and advice regarding the appropriateness of the research topic. This step will conclude with a selected research topic. Students are encouraged to start this step as early as possible.
2. Student develops their research proposal. This involves preliminary literature review to confirm the research topic; clarification of research goal, methodology, and work plan; and preparation of a formal written proposal for the Research Advisor review. See Section 2.3 for proposal content requirements.
3. Research advisor reviews and comments on the proposal. Student then revises the proposal accordingly and prepares the final version proposal for online submission in CNST6100 blackboard.

Outcomes of the proposal evaluation by the CM faculty include:

* **Pass**. With a passing proposal, students can proceed with the 1st semester research in a subsequent semester. For CNST6100 grading purpose, students will receive 50% credit toward the final grade (the remaining 50% is based on CNST6100 quizzes and homework).
* **Fail**. If the proposal fails to obtain the CM faculty approval, students will receive 0% for the term paper, and an “Incomplete” grade in CNST6100 will be assigned. Students must revise their proposals for approval in the immediate following semester. Failure in passing the proposal evaluation in two full semesters after the CNST6100 enrollment will result in a “F” grade automatically recorded in CNST6100. Please note that students are not allowed to enroll in a research course CNST6396/6399 without a passing proposal. Once the proposal is approved, students must make a request to their Research Advisor who shall send a confirmation to CNST6100 instructor, so that the “Incomplete” grade can be changed to a letter grade. Thereafter, students can then start their master research.

*A note for students who completed CNST6100 prior to Fall 2014: students will need to consult their Research Advisor on topic selection, develop a proposal, and submit the proposal for review and approval.*

## 2.3 Proposal Content Requirements

The research proposal should discuss the background, problem statement, objectives, preliminary literature review results, proposed research methodology, research tasks, and a time schedule in 4-6 pages. The following are typical elements of a quality proposal:

* Research title: a concise and meaningful title, highlighting the research area and contribution.
* Background: a description of the basic facts and importance of the research area – What is your research area, the motivation of research, and how important is it for the industry practice/knowledge advancement?
* Problem statement: a clear concise description of the issues that need to be addressed – What is the specific problem in that research area that you will address (e.g. lack of understanding of a subject, low performance …)?
* Objectives: a list of objectives that will be achieved through the proposed research – What are the benefits/impact (e.g. better understanding, better processes or tools …) that will be generated if the research problem is answered?
* Literature review: a summary of previous related research on the research problem, their strength and weakness, and a justification of your research – What is known/what have been done by others? And, why your research is still necessary?
* Research methodology: defines the research methods and logic steps – What to do and how to solve the problem and achieve proposed objectives? Which research methods (e.g. survey, modeling, case study …) will be used and why?
* Project schedule: a list of research activities, deliverables, and due dates.

Please use the following proposal template and guideline to develop your proposal. It may be refined to reflect a particular research project.

* [**Proposal template**](http://www.uh.edu/~lsong5/documents/Proposal%20template.docx)

Below is a sample proposal for your reference.

* [Sample research proposal](http://www.uh.edu/~lsong5/documents/Sample%20proposal.pdf)

## 2.4 Recommended Proposal Development Timeline

To ensure a successful completion of your research proposal, please start brainstorming your potential research topics as early as possible, and follow the suggested milestones and target dates in the table below.

|  |  |  |
| --- | --- | --- |
| **#** | **Milestone** | **Suggested Target Date** |
| 1 | Brainstorming for potential research topics | 4th week |
| 2 | Preliminary literature review | 6th week |
| 3 | Consult Research Advisor to confirm topic selection | 8th week |
| 4 | Develop & submit proposal for Research Advisor review | 12th week |
| 5 | Revise proposal and submit in Blackboard | See CNST6100 Blackboard |
| 6 | Proposal review & approval decision by CM faculty | By the end of semester |

# 1st and 2nd Semester Research

## 3.1 Course Registration

With a passing proposal, the student is eligible to start the 1st semester research by contacting the Research Advisor, who will provide instruction on how to register the research course CNST6396/6399 (e.g. obtaining the class number). Similarly, if the progress of the 1st semester research is satisfactory, students should contact the Research Advisor for register the 2nd semester research. The Research Advisor will also provide students with detailed guidelines on performance and reporting requirements for a particular semester. The following discussion provides a general guideline.

## 3.3 Research Committee

A research committee will be formulated to provide oversight to your research. Your Research Advisor will be the Chair of the committee and the Committee Members will include at least one more CM faculty member. A third member, either a faculty member or an industry expert, may also be assigned. Please consult your Research Advisor for selecting the Committee Members.

## 3.2 Progress Expectation

Every research study is a unique piece of work. Please discuss with the Research Advisor about specific progress and reporting requirements for each semester of research. The following can serve as a general guideline of required progress:

* 1st Semester: Refine the research problem/proposal (problem statement, objective, scope, methodology etc.); conduct full literature review; start implementing research methodology (e.g. historical data collection, survey design, application development … targeting for at least a 50% completion); and document 1st semester research in a technical report.

*Please note: to ensure the success of a research project, proper progress during the 1st semester research must be maintained. Inadequate progress will result in a “F” grade. In this case, students will not be able to continue into the 2nd semester of research until the 1st semester work is completed with a passing grade.*

* 2nd Semester: Complete research implementation and draw conclusions; present the research; and submit final report and manuscript for potential conference/journal publications.

## 3.4 Performance Evaluation

A letter grade will be assigned based on the quality and progress of student research work in each semester. The letter grade is assigned based on the following criteria:

* **Research quality**: academic contributions/potential for publications
  + The topic is significant and worth investigation.
  + The study is logically structured and conducted.
  + The solution/conclusion proposed is meaningful and practical.
  + Innovative solutions/techniques that improve industry performance and/or knowledge in a significant practice area provide better academic values.
  + From a publication perspective, a good research can lead to conference papers, and a comprehensive and well-executed research producing new knowledge can lead to academic journal publications.
* **Work progress**: maintaining a satisfactory progress according to the work plan and Research Advisor’s expectations.
* **Progress reporting**: timeliness and quality of progress reporting during the semester.
* **Presentation**: quality of PowerPoint presentation:
  + The presentation is well organized and logically presented.
  + The speaker speaks clearly and effectively.
  + The speaker efficiently utilizes the time available.
  + The speaker addresses well questions from the audience.
* **Final report/manuscript**:
  + The report/manuscript follows the correct template/format required.
  + The report/manuscript has a logic structure and easy to understand.
  + The report/manuscript uses correct grammar and spelling.
  + The report/manuscript uses correct citation & reference format and writing style (see Appendix A and B).

## 3.5 Progress Reporting & Meeting

Good communication helps to ensure the project stay on the right track toward a successful completion. Regular progress report, research presentation, and individual meeting will be arranged by the Research Advisor.

# Final Report Requirements

## 4.1 Final Report Organization & Template

The final report (for both 1st and 2nd semester) should include the following sections in the order listed below. Please use the final report template below to prepare your report.

* [Final report template](http://www.uh.edu/~lsong5/documents/Final%20report%20template.docx)

Final report sections:

1. Title Page
2. Signature page
3. Acknowledgment page (Optional)
4. Abstract page (an abstract of the research within one page)
5. Table of Contents (Table of figures and tables are optional)
6. Text (e.g. Chap. 1, 2 …)
7. References
8. Appendix (optional)

## 4.2 Style Requirements

The preferred format is the ASCE Preparation of Manuscripts. Refer to the ASCE guidelines in Appendix A Reference and Citation and Appendix B Writing Style for details.

## 4.3 Report Editing

To ensure the quality of technical report writing, the final reports must be professionally edited. You can find any capable person to act as a professional editor to review your report to ensure that the report is free from spelling and grammar issues.

## 4.4 Report Submission

Final report submission (for both 1st and 2nd semester) will be in electronic format by email to the Research Advisor.

# Conference/Journal Publications

Preparing a paper for potential conference/journal publication is a requirement of the 2nd semester master research. Publication provides an excellent opportunity to share your expertise and knowledge gained through your master research with the industry and the rest of the world.

Your work maybe published as either a conference paper or a journal paper. In either case, you will prepare the manuscript based on the final report. In essence, the manuscript is an abbreviated version of the final report. Typical sections of a manuscript include:

1. Title and authors
2. Abstract (within 200 words)
3. Background/problem statement (problem statement, goal, scope, and a short final paragraph discussing the paper structure to guide readers)
4. Literature review (review past related work and their approach and results; in a final paragraph, summarizing what works, what doesn’t, what is missing, and justify your research)
5. Methodology/system design (describe conceptually what is your solution/proposed method, how it works conceptually – not only WHAT but also WHY, and how it can be achieved)
6. Implementation/results (describe implementation of your research methodology, demonstrate results achieved, the benefits … this is also the place to present case study – real-world application of the proposed method)
7. Discussion/conclusion (a summary of what the research has done , lessons learned, comments on future research needs)
8. Acknowledgement (optional)
9. Reference.

Once the research is concluded and the final report completed, use the following sample paper as a template to compile the manuscript. However, if you intend to submit the paper to a particular conference/journal, please use their template instead. Writing style, citation and reference described in the appendixes are also applicable to the manuscript preparation.

* [**Manuscript template/sample**](http://www.uh.edu/~lsong5/documents/Manuscript%20template.doc)

If your research has a good potential for publication, your Research Advisor will work with you to identify a particular publication venue (e.g. ASCE, CRC, ASC, AACE, PMI conferences or construction research journals). Once identified, you will need to follow their paper formatting requirements and submission deadlines when plan your research project. Please consult the Research Advisor on publication issues, such as confidentiality of sensitive business data and paper submission procedure.

# Sample Student Work

1. Sample research proposal
2. Sample student publications

* [Sample student paper 1 – Material management](http://www.uh.edu/~lsong5/documents/Sample%20student%20paper-1.pdf)
* [Sample student paper 2 – Design simulation](http://www.uh.edu/~lsong5/documents/Sample%20student%20paper-2.pdf)
* [Sample student paper 3 – Active learning](http://www.uh.edu/~lsong5/documents/Sample%20student%20paper-3.pdf)
* [Sample student paper 4 – Remote sensing](http://www.uh.edu/~lsong5/documents/Sample%20student%20paper-4.pdf)

1. [Sample student presentation slides](http://www.uh.edu/~lsong5/documents/Sample%20presentation%20-%20Linear%20scheduling.ppt)
2. Sample student reports
   * [Sample project report – Quality Management](http://www.uh.edu/~lsong5/documents/Sample%20project%20report%20-%20Quality%20management.pdf)
   * [Sample project report – Lean Construction](http://www.uh.edu/~lsong5/documents/Sample%20project%20report%20-%20Lean%20construction.pdf)
   * [Sample thesis – Space Modeling & Planning](http://www.uh.edu/~lsong5/documents/Sample%20thesis%20-%20Space%20modeling%20&%20planning.pdf)

5.   Sample student oral presentation (on-line session)

* [Sample research progress presentation](http://www.uh.edu/~lsong5/Sample_progress_presentation.mp4) By Earl Ritchie

# Appendix A: Citation & Reference Format

Please follow this ASCE guideline in preparing your research report.

All factual material that is not original with you must be accompanied by a reference to its source.

ASCE books and journals prefer the author–date system of referencing. This system has two parts, the text citation and the reference list.

* The text citation appears where the material to be cited is presented. The citation refers readers to a source in the reference list by the author’s name and the year of publication. Often, the author and date appear in parentheses; a comma is not placed between them.

For example: One recent report (Carson 2006) finds evidence that…

Or: …yielded varying results (Jones 2005; Marks and Smith 2004a,b).

* Use the first author’s name followed by “et al.” in citations for publications with three or more authors.
* When the researcher is part of the sentence, the last name does not need to be repeated.

For example: Carson (2006) finds evidence that…

* The reference list appears at the end of your report with a title of “Reference.”
* References begin with the names of the author(s), last name first for all authors, followed by the year of publication in parentheses. See the Quick Guide to Common Types of Referenced Materials below for guidance on punctuation and formatting.
* References by the same author(s) published in the same year are designated with lowercase letters: 2004a, 2004b.
* Every reference must have a text citation AND every text citation must have a corresponding reference.
* Reference lists should be prepared double-spaced and submitted as word- processed files.

**Quick Guide to Common Types of Referenced Material**

**Journal References**

Include year, volume, issue, and page numbers.

Stahl, D. C., Wolfe, R. W., and Begel, M. (2004). “Improved analysis of timber rivet connections.” J. Struct. Eng., 130(8), 1272-1279.

**Conference Proceedings and Symposiums**

Include the sponsor of the conference or publisher of the proceedings, AND that entity’s location—city and state or city and country.

Garrett, D. L. (2003). “Coupled analysis of floating production systems.” Proc., Int. Symp. on Deep Mooring Systems, ASCE, Reston, Va., 152-167.

**Books**

Include author, book title, publisher, the publisher’s location, and chapter title and inclusive page numbers (if applicable).

Zadeh, L. A. (1981). “Possibility theory and soft data analysis.” Mathematical frontiers of the social and policy sciences, L. Cobb and R. M. Thrall, eds., Westview, Boulder, Colo., 69-129.

**Reports**

Same as for books, as above. For reports authored by institutions: spell out institution acronym on first use, and follow with acronym in parentheses, if applicable. If subsequent references were also authored by that same institution, use only the acronym. For reports authored by persons, include the full institution name—no acronym—and its location.

**Unpublished Material**

Unpublished material is not included in the references but may be cited in the text as follows: (John Smith, personal communication, May 16, 1983; J. Smith, unpublished internal report, February 2003).

**Web Pages**

Include author, copyright date, title of “page,” Web address, and date material downloaded.

Burka, L. P. (1993). “A hypertext history of multi-user dimensions.” MUD history, <http://www.ccs.neu.edu> (Dec. 5, 1994).

**CD-ROM**

Include authors, copyright date, titles, medium, and producer/publisher and its location.

Liggett, J. A., and Caughey, D. A. (1998). “Fluid statics.” Fluid mechanics (CD-ROM), ASCE Press, Reston, Va.

**Theses and dissertations**

Include authors, copyright date, title, and the name and location of the institution where the research was conducted. Note that some institutions use specific terminology; for example, "doctoral dissertation" rather than "PhD thesis".

Sotiropulos, S. N. (1991). "Static response of bridge superstructures made of fiber reinforced plastic." MS thesis, West Virginia Univ., Morgantown, W.Va.

**An Example**

Ballard, G. (2000b). “Lean project delivery system.” Lean Construction Institute, <http://www.leanconstruction.org/lpds.htm> (Jul. 29, 2008).

Bovey, W. H., and Hede, A. (2001). “Resistance to organizational change: The role of defense mechanisms.” J. Managerial Psychology, 16(7), 548-553.

Choo, H. J. (2003). Distributed planning and coordination to support lean construction. Ph.D. Dissertation. Univ. of California, Berkeley, Calif.

Choo, H. J., Tommelein, I. D., Ballard, G., and Zabelle, T. R. (1999). “WorkPlan: Constraint-based database for work package scheduling.” J. Constr. Engrg. and Mgmt., 125(3), 151-160.

Chua, D. K. H., Shen, L. J., and Bok, S. H. (2003). “Constraint-based planning with integrated production scheduler over Internet.” J. Constr. Engrg. and Mgmt., 129(3), 293-301.

Forsberg, A., and Saukkoriipi, L. (2007). “Measurement of waste and productivity in relation to lean thinking.” Proc., 15th Annu. Conf. on Lean Constr., East Lansing, Mich., 67-76.

Halpin, D. W. and Kueckmann, M. (2002). “Lean construction and simulation.” Proc., 2002 Winter Simulation Conf., San Diego, Calif., 1697-1703.

Halpin, D. W., and Riggs, L. S. (1992). Planning and analysis of construction operation. Wiley, New York.

# Appendix B: Writing Style

The following is quoted from ASCE website.

* 1. Figures, Tables, and Other Supporting Materials
  2. Acronyms and Abbreviations
  3. Active versus Passive Voice
  4. Direct versus Indirect Statements
  5. Inclusive Language
  6. SI versus Customary Units

**1. Figures, Tables, and Other Supporting Materials**

Elements such as figures, tables, and boxes containing lists or case studies are included to support or augment what appears in the text.

* For books/reports, each element should be numbered consecutively with the chapter number and an Arabic numeral: Fig. 9-1, Fig. 9-2, Fig. 9-3 …; Table 7-1, Table 7-2 …; Box 10-1, Box 10-2 …. For journal articles and conference proceedings volumes, which do not have chapter numbers, the chapter number is left out: Fig. 1, Fig. 2, Fig. 3....
* If a figure or table has parts, a capital or lowercase letter is used to identify the parts: Fig. 9-1A, Fig. 9-1B…; Fig. 1(a), Fig. 1(b)…
* In books, do not use subheading numbers for figures and tables. This practice is awkward and confuses readers.
* Every element must be discussed in text, with a reference to the element and its number. The first reference to a figure, table, or box is the call-out. The call-outs must be worded consistently throughout your manuscript. Spell out “Table” and abbreviate “Fig.” For example: "The results of the stress tests (Fig. 1) clearly demonstrate…" and "Table 6-2 presents a range of planning options along with…".
* When your manuscript is typeset, the element will be placed on the page on which it is called out—or as soon as possible thereafter.
* Tables and figures must be numbered in the order in which they are discussed in text so that call-outs also appear in numerical order. In other words, Table 3 must be called out in text before Table 4.

**2. Acronyms and Abbreviations**

An abbreviation is a shortening form of a word or phrase, such as “Jan.” for “January”, “U.S.” for “United States,” and “ASCE” for “American Society of Civil Engineers.” An acronym is formed when the abbreviation forms a pronounceable word, such as “NATO” for “North Atlantic Treaty Organization” or “AASHTO” for "American Association of State Highway and Transportation Officials."

* Abbreviations and acronyms in text must be spelled out the first time that they appear in each chapter or paper, with the shortened form appearing immediately in parentheses. Thereafter, the shortened form should be used throughout the chapter.
* Several very common abbreviations (U.S. and U.K. as adjectives; DNA and PVC for nouns) do not need to be spelled out on first usage.
* Basic units of measure do not need to be spelled out on first usage. These include: ft, in., lb (customary) and m, mm, kg (SI).

**3. Active versus Passive Voice**

Wherever possible, use active verbs that demonstrate what is being done and who is doing it.

Instead of: The bridge was built by James Eads.

Use: James Eads built the bridge.

Instead of: Six possible causes of failure were identified in the forensic investigation.

Use: The forensic investigation identified six possible causes of failure.

**4. Direct versus Indirect Statements**

Direct statements are clear, concise, and do not wear on your reader. Indirect statements are those that begin with phrases such as “it should be noted that…” or “it is common that….” Other types of indirect statements may begin with “to be” statements such as “there are” or “it was”.

Instead of: It should be noted that the flow was interrupted by a surge…

Use: A surge interrupted the flow…

Instead of: It is common that the steel rebars are weakened by oxidation…

Use: Oxidation commonly weakens steel rebars…

Instead of: There are many reasons that concrete may fail…

Use: Concrete may fail for many reasons…

Instead of: There are three kinds of bolt that can be used in these circumstances…

Use: Three kinds of bolt can be used in these circumstances.

**5. Inclusive Language**

Writing without bias may feel stiff or unnatural at first, but usually results in greater precision and consideration for your readers. Therefore, avoid language that arbitrarily assigns roles or characteristics or excludes people on the basis of gender; racial, ethnic, or religious background; physical or mental capabilities; sexual orientation; or other sorts of stereotypes.

* Avoid using man or men to refer to groups containing both sexes. Substitute words and phrases such as humankind, humanity, people, employees, workers, workforce, staff, and staff hours.
* Avoid the use of masculine pronouns to refer to both sexes. Use plural pronouns, a locution that carries no bias, imperative verb forms, or second-person pronouns.

Instead of: When an engineer begins to design an overpass, he should consider…

Try: When engineers begin to design overpasses, they should consider…

Or: When beginning to design an overpass, an engineer should consider…

Instead of: A manager should not assume that his staff will alert him to potential problems.

Try: As a manager, do not assume that staff will alert you to potential problems.

Or: As a manager, you should not assume that your staff will alert you to potential problems.

**6. SI versus Customary Units**

ASCE publications use Système Internationale (SI) units, the most widely and officially recognized system of metric units, as the primary system of weights, dimensions, and other physical measures. For more information about SI units, visit the Web sites of

the U.S. Metric Association (USMA), Inc. or the National Institute of Standards and Technology (NIST) or consult the book, Metric Units in Engineering: Going SI.

All ASCE publications use SI units in text, figures, and tables. Customary (also known as English or imperial) units may be included in parentheses, if the author chooses.

One exception is recognized for ASCE Press titles. Case studies, examples, and problem sets can become difficult to use when both systems of units are presented. Therefore, it is acceptable to alternate metric and customary units in cases, examples, or problems.