

The 2021-2022
Department of Civil and Environmental Engineering

SENIOR THESIS GUIDE

A Compendium of dates, tips, guidelines and procedures



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INTRODUCTION

This senior thesis guide applies to all CEE students who are satisfying the senior thesis requirement by signing up for CEE 478. Senior thesis can be co-advised by several faculty from CEE or out of CEE; however, at least one faculty from CEE must be co-advisor. Students in the “Architecture and Engineering – Architecture Focus” track are also responsible for meeting the requirements of the School of Architecture. They must contact the Undergraduate Administrative Assistant in Architecture to obtain the school’s guidelines and deadlines. Typically, this means making final presentations in both CEE and in the School of Architecture. Students in the geological engineering track have the choice to make the oral presentation in either the CEE Department or the Department of Geosciences.

The senior thesis *is a full-year effort*. It counts as two courses towards graduation (one taken in fall and one in spring). Students should budget their efforts accordingly. This guide provides key dates and deadlines as well as the rules and procedures governing the preparation of the final document. It also is intended to help develop a schedule that will avoid the typical thesis rush at the end of the year, while at the same time providing tips on how to organize the thesis. Procedures for obtaining extensions (for extreme circumstances) and tips on the oral presentation at the end of the year are also provided.

IMPORTANT DATES AND DEADLINES

<i>First week of fall semester</i>	MEET YOUR ADVISOR(S)
<i>Friday, October 8, 2021</i>	SENIOR THESIS PROPOSAL Deadline (Friday before the mid-term)
<i>Friday, December 10, 2021</i>	POSTER PRESENTATION (Friday of the Fall Semester Reading Period)
<i>Tuesday, December 14, 2021</i>	INTERIM PROGRESS REPORT Deadline (last day of Fall Semester Reading Period)
<i>Monday, April 4, 2022</i>	SENIOR THESIS SUBMISSION Deadline (Fourth Monday after Spring Break)
<i>Wednesday, April 27, 2022</i>	ORAL PRESENTATIONS (Wednesday of Spring Reading Period)

All reports, the poster, and the thesis must be submitted to the CEE department by 5:00 pm on the date indicated. Late submission of the senior thesis proposal or interim progress report is penalized at a rate of one letter grade per day. Late submissions of the thesis will be penalized at a rate of one third of a letter grade per day.

For additional information on what needs to be submitted and how to make submission, as well as how the thesis is graded, see the sections in the remainder of this guide.

COURSE LEARNING OBJECTIVES FOR CEE 478 SENIOR THESIS

The following learning objectives constitute the minimum skills that every student must acquire through the senior thesis experience. These objectives will be used, in part, to evaluate the student's work and in the assignment of a grade.

Course Learning Objectives	ABET* Criterion 3
1. Integrate science and engineering principles for analysis and solution of problems in the field of civil and environmental engineering.	1
2. Combine in-depth science/engineering analysis with examination of societal issues related to the thesis topic. Gain broad knowledge about the topic of interest, and appreciate its relevance in modern society.	4
3. Formulate the thesis research project. Identify the critical research questions, and define the scope and objectives of the project. Design experiments, analysis, or observation plan.	1
4. Examine a range of investigative options for approaching the research questions, such as experimentation, field observation, simulation, optimization, economic analysis, or risk assessment. Defend the method chosen for approaching the research.	7
5. Know how to use information technology resources to find background information and data pertinent to the thesis topic. As needed, gain the skills to use laboratory techniques and software for data analysis and simulation.	1,2,6,7
6. Apply appropriate paths of inference to interpret the theory, findings, and/or data. Use these interpretations to draw conclusions with regard to the project objectives.	6
7. Behave as a responsible professional engineer with respect to planning and meeting project deadlines, regularly reviewing progress with advisors, and being responsive to feedback from advisors and peers. Become familiar with the ethical standards of technical writing with respect to giving credit: acknowledging other contributors, acknowledging funding sources, citing references.	4
8. Develop writing skills and presentation skills needed to effectively communicate the purpose, scope, and conclusions of the project.	3

* ABET <http://www.abet.org> is among the most respected accreditation organizations in the United States, and accreditation ensures that academic programs meet established standards of engineering and technical education.

SENIOR THESIS FUNDS

Seniors in the School of Engineering and Applied Science may apply for support for senior thesis and independent work research from funds administered by the SEAS Dean's Office.

These funds are normally budgeted for consumable supplies, software, small equipment and parts, and travel for field experiments. They specifically do not cover conference travel, books and journals, food and refreshments, copying and thesis preparation costs, or capital equipment.

Funding per project will normally not exceed \$600; requests above that amount will be considered only if accompanied by a letter of special request from your adviser. All awards are contingent on the availability of funds.

There are two funding rounds annually. Applications for fall term projects and senior theses (and reimbursement for direct thesis research expenses incurred during the summer – contact Dean Bogucki for eligible expenses) are due on October 15th; applications for spring term projects are due on February 15th.

Application forms are sent early each semester. Application consists of a 1-2 page proposal, endorsement of your adviser on the application sheet, and a signed waiver of liability form.

SENIOR THESIS COLLOQUIUM

Work related to senior thesis has a strong research component and the thesis itself is a document that require specific way of writing and presentation. Both these aspects might be new for undergraduate students, especially those who did not perform any research prior to thesis. In order to help students to learn how to organize the work related to thesis as well as how to write the thesis, CEE offers Senior Thesis Colloquium.

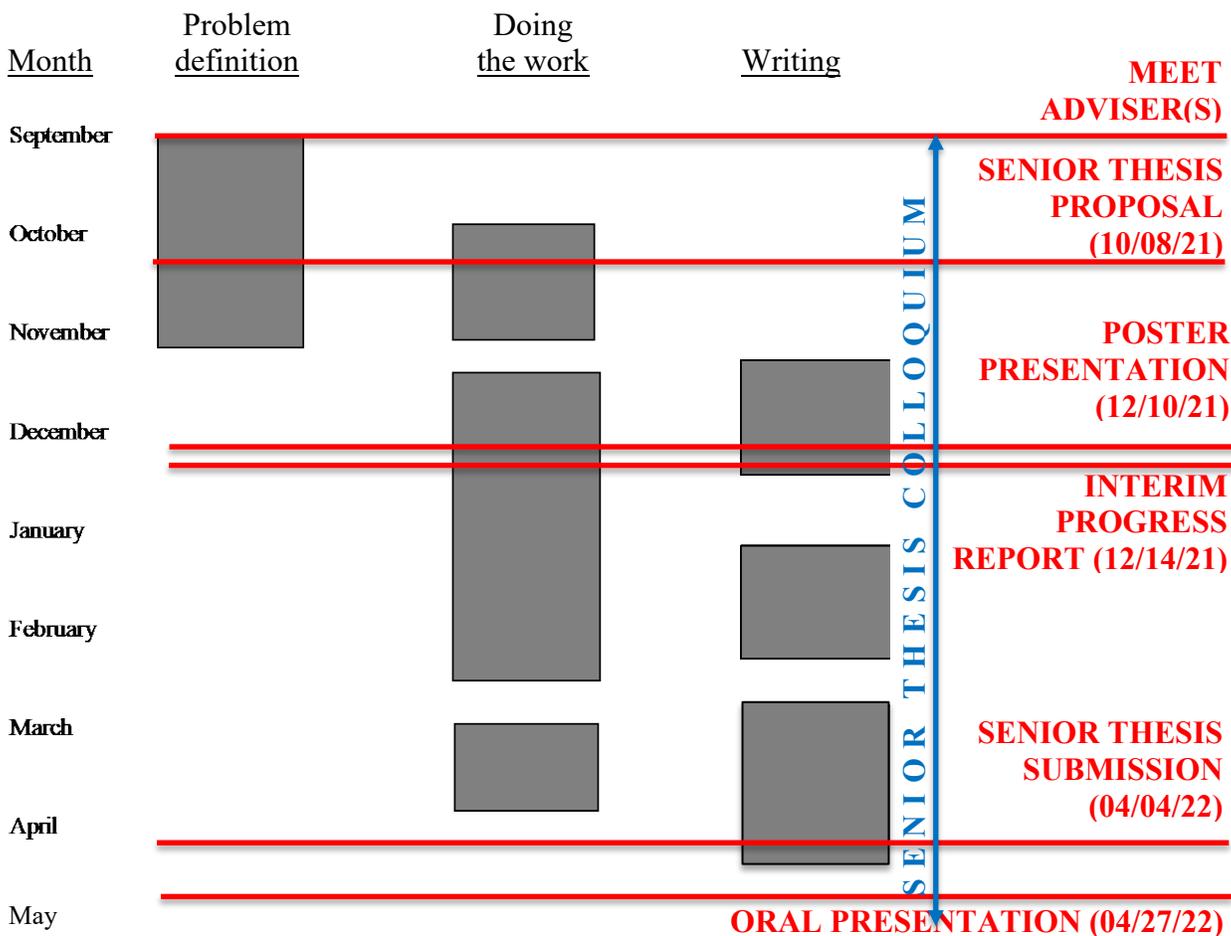
The colloquium is led by a CEE graduate student who is in their 4th or 5th year of Ph.D. study and who has experience in successfully conducting research and publishing specialized journal articles. The colloquium consists of lectures and practical exercises during the sessions that happen approximately every two weeks (schedule depends on progress). Attendance to Senior Thesis Colloquium is an important part of senior thesis work and it counts 5% of the thesis grade.

ORGANIZING YOUR TIME

One of the biggest challenges is estimating how much time it takes to complete certain tasks, in particular the actual writing of the thesis. It may be helpful to divide the effort into three primary tasks:

- Defining the problem and reviewing the literature
- Getting data and doing the work
- Writing the thesis

Depending on the nature of the work, each task can be viewed as requiring approximately the same amount of calendar time (the number of hours spent per day, however, can vary widely). Naturally, the three tasks will overlap, since you may have to do additional literature review when you finally settle on a specific problem, and it is often useful to begin writing certain sections of the thesis while the actual research is in progress. Do not underestimate how long it takes to write the thesis, and be sure to allow sufficient time for printing, copying, and binding the thesis (if you decide to do it – printing, copying and binding is optional, see later text). An approximate time schedule is shown below.



THE SENIOR THESIS PROPOSAL

The senior thesis proposal comprises 5 % of your CEE 478 grade. Late submissions of reports are penalized at a rate of one letter grade per day.

This document should be submitted electronically as a single PDF file by uploading to the SharePoint via a link that you will receive from the Department a month before the deadline.

This proposal is intended to serve as an initial checkpoint on your progress and provides an early opportunity for feedback. It will be graded by your advisor(s) and hence you should discuss with them what is expected. In general, however, the proposal is expected to be at least five pages in length (font 12, one and one half or double space). The basic outline of the proposal would normally be as follows:

- Problem description, a broad statement of your goals and research questions, and the scope of your proposed work.
- Description of what you propose to do with the topic: your approach and methods. This includes, for example, conducting experiments, performing engineering design, conducting surveys, and statistical analysis of data.
- Preliminary review of the background literature, including a list of cited references.
- Summary of major data requirements, if applicable, and a back-up plan if data are not available or cannot be generated
- Schedule of tasks (attempt to estimate major milestones on a time-scale of weeks).

THE POSTER SESSION

Seniors are required to present their thesis projects and their fall-semester progress in the form of a poster presentation. This presentation counts as 5% of the CEE 478 grade. Prepare a poster that summarizes your work in graphical and written form. The poster size should be 30'' x 40''. Format the poster so that it can be easily viewed by someone standing a few feet away. Details of poster printing and formatting will be emailed to you in advance.

In addition, you must submit the poster electronically as a PDF file by uploading to the SharePoint via a link that you will receive from the Department a week before the poster presentations.

At the poster session, easels will be provided for you. You will stand at your poster, and you should be prepared to explain your topic and your progress to the professors and other participants who stop by. Your poster will be evaluated by minimum three evaluators.

THE INTERIM PROGRESS REPORT

The interim progress report is a summary of progress at the end of the fall semester. It counts 10 % of the final CEE 478 grade. Combined with the senior thesis proposal, the poster and thesis colloquium, the work you do in the fall will count a total of 22.5 % of the final CEE 478 grade. Poor progress in the fall, then, can produce as much as a two-grade reduction in your final thesis grade, regardless of the grade given on the thesis itself. Late reports are penalized at a rate of one letter grade per day.

Include your name, your advisor's name and a tentative thesis title. This document should be submitted electronically as a single PDF file by uploading to the SharePoint via a link that you will receive from the Department a week before the deadline.

The interim progress report will be graded by your advisor(s), and hence you should talk to them regarding the contents of the report. A suggested format for the report is as follows:

Part I: Introduction

What is the problem that you are addressing? What is the motivation for the work? What are the specific objectives? What is the scope of your work? An early version of this will already have been in your fall progress report, but here you should update and refine it.

Part II: Summary of Approach and Methods

Present an updated and refined summary of your approach and methods, including experimental plan, engineering designs, data sources, and analyses to be conducted. Clearly state how your plans have changed since your last report.

Part III: Review of the progress made to date

Summarize specific tasks already completed, such as the literature review, development of a mathematical model, conceptualization and/or actual design of a component/structure, software, *etc.* List tasks by general titles with short descriptions. Close this part with conclusions about work carried out and presentation of future work.

Part IV: Literature review of references and sources of data

This list should include a reasonably complete bibliography covering your topic. Each bibliographic item should be annotated or described in the text explaining its importance to your project. Also include all sources of data that you have been using or plan to use in the spring.

Part V: Timeline and list of tasks

Present an updated timeline and list of tasks to be completed in the spring. Included in this list should be the task of writing and rewriting the thesis, broken down into specific chapters. Make sure to schedule sufficient time for printing, copying and binding.

WHAT IS A THESIS?

This section of the guide is a set of guidelines that students may use to orient themselves as to the basic components of a thesis. Since projects differ widely, it is impossible to develop a general outline that applies equally to all students. Regardless of how well you think your own research fits the following guidelines, you should talk to your advisor to determine the most appropriate style of presentation for your own work.

The essence of any scholarly work is to establish the following:

- Definition of the problem and review of the literature
- Presentation of your particular contribution to this area
- Identification of fruitful areas of further research

Toward these three goals, the following list of questions may prove useful for organizing both your research effort and the final writing of the thesis.

I. What are you looking at?

You must begin by defining the problem. Do this in the introduction of the thesis along with delineation of the scope of the project.

II. Why are you looking at it?

Motivate your work. Establish who will benefit from your work and why. What societal issues are impacted by this problem?

III. How are you looking at it?

What approach are you taking? (experimental, observational, analytical, theoretical, engineering design) What are the specific research objectives and research questions that you will address, and what methods will you apply for each?

IV. Who else looked at it?

Establish what is the state of the art in the area. How does your work expand on existing work in this area? Is it a novel research question or novel design? Or are you looking at an old research question but in a new way?

V. What are findings?

Present the data that you generated or collected. Explain how you interpret these findings. Explain the methods for your inferences. Discuss your findings in the context of the hypotheses or conjectures that you discussed in the introduction.

VI. What are the limitations of your work?

If you were limited by your data, explain how you think this might affect the generality of your conclusions. Discuss openly any simplifying assumptions required due to time/budget/data availability constraints.

VII. What are your conclusions (and recommendations)?

What conclusions can you draw from your research? This section is usually brief, and usually serves to summarize the entire thesis. Also talk about the implications of the conclusions and make recommendations based on these implications, as appropriate. The conclusions section may also talk about areas for future research.

FORMAT OF THE THESIS

There are certain guidelines that must be followed when preparing the copies that will be turned in. These guidelines have been developed as a response to certain legal requirements regarding copyrights as well as administrative needs for processing the thesis.

The requirements for preparing the thesis are as follows:

The front page of the thesis must include:

Title

Author

Date

Submitted in partial fulfillment
of the requirements for the degree of
Bachelor of Science in Engineering
Department of Civil and Environmental Engineering
Princeton University

The second page should contain the following statements:

I hereby declare that I am the sole author of this thesis.

I authorize Princeton University to lend this thesis to other institutions or individuals for the purpose of scholarly research.

(your signature)

(your name)

I further authorize Princeton University to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

(your signature)

(your name)

Other requirements include:

- The thesis may be formatted one and one half spaced or double spaced, with the exception of footnotes and bibliography which should be single-spaced
- The font size should be 12 point.
- The left hand margin should be 1 1/2 inches to allow for binding; all other margins should be 1 inch.
- Color graphics may be included but they should be clear when reproduced in gray-scale.

Paper:

Printing and bounding the thesis is optional. If you decide to print and bound your thesis, it is recommended that your thesis be printed on acid free, archival quality bond paper (20 to 24 pound substance), 8 ½ × 11 inches in size, for permanence and durability.

THE WRITING CENTER

Located in Lauritzen Hall, the Writing Center offers free one-on-one conferences with experienced fellow writers trained to consult on assignments in any discipline. The Writing Center holds 50-minute regular conferences seven days a week. Extended 80-minute sessions are also available for thesis writers. Appointments should be scheduled online via <https://writing.princeton.edu/scheduler/appointments/>. Students are also welcome to stop by during drop-in hours Sunday through Thursday evenings, 7pm – 10pm, when classes are in session. No appointment is required for drop-in hours.

LIBRARY SUPPORT

To learn how to effectively navigate the library system for your research projects in Civil and Environmental Engineering, you are encouraged to consult with Willow Dressel, Engineering Librarian in the Engineering Library at Friend Center (wdressel@princeton.edu). Copies of past CEE theses can be examined either from the Department Undergraduate Program Office E211 or in Mudd Library.

RESEARCH SUPPORT

The Office of Undergraduate Research website <https://undergraduateresearch.princeton.edu> is the central hub for information about undergraduate research including student-authored research advice on the PUCR blog, departmental Independent Work Guides, funding opportunities, etc. Students should also regularly check the Princeton Undergraduate Research Calendar (PURC), the central calendar for upcoming events and deadlines, on the website for upcoming programming and workshops, which cover topics ranging from preparing funding proposals to note taking, and from making an argument to draft review.

TURNING IN THE THESIS

Students should turn in their thesis to the SharePoint link by 5:00 PM of the deadline. Please do not submit a thesis directly to advisors. When you submit the thesis to the SharePoint, your advisor(s) and reader(s) will also receive the submission. Each thesis will be read and evaluated by the advisor(s) and a second faculty reader assigned by the Department. Theses that involve co-advising of several faculty will be read and evaluated by each co-adviser.

Breakdown of what to submit online:

- a PDF file of the thesis by uploading to the SharePoint via a link that you will receive from the Department a week before the deadline.
- a PDF file of the thesis uploaded to the Mudd Library centralized Senior Thesis Submission Site <http://thesis-central.princeton.edu> by the Department deadline*. *Instructions for students can be found here:* <https://rbsc.princeton.edu/policies/senior-thesis-submission-information-students>

Breakdown of what to submit to E211 (optional):

- One printed copy for the advisor(s) (*Optional*)
Out of courtesy it is convention to give a bound copy to your thesis advisor(s).
- One printed, unbound copy for the second reader (*Optional*)
Out of courtesy an unbound copy could be either single or double-sided, and come with binder clips or in a folder.

EXTENSIONS

Extensions for turning in the thesis will be granted only in the case of illness or family emergencies and only when such illness or emergency makes it impossible to complete the thesis on time. All extensions must be requested in writing and turned in to the professor who is the Director of Undergraduate Studies **at least one week prior to** the deadline for the thesis. After consultation with the student's advisor, the department will consider the request for the extension. Extensions will not be granted for unexpected delays due to problems in computing, file saving, printing, photocopying, or binding the thesis. Even though these may be beyond your immediate control, you still bear the responsibility for getting the thesis in on time.

THE ORAL PRESENTATION

Capping the thesis effort is a day of oral presentations where seniors have a chance to stand up and describe their work to a broad audience. Attendance is required. Failure to make an oral presentation on time will result in a one letter grade penalty. If you have other commitments on the day of the presentation, contact the Undergraduate Departmental Representative at least one week in advance, and it may be possible to schedule around these commitments. In case of conflict, however, the oral presentation takes precedence. The schedule of presentations will be available a week before the presentation day.

Students in the geological engineering track have the choice to make the oral presentation in either the CEE Department or the Department of Geosciences. You must inform the CEE Departmental Representative prior to April 1, of the department in which you wish to make your presentation.

The presentation must be **NO MORE THAN 12 MINUTES**. There will then be 3 minutes for question and answer. Failure to allocate the time for questions will result in grade penalty. As it is very easy to run over this time limit, it is important to practice your presentation ahead of time. This is a formal presentation, so dress professionally.

GRADING

The Civil and Environmental Engineering theses are graded according to the grading basis shown on the following page. Each thesis is graded by the primary thesis advisor, all co-advisors (if any), and/or a second faculty reader assigned by the Department.

The final course grade for CEE 478 is determined as follows:

Thesis Colloquium	5%
Senior Thesis Proposal	5%
Interim Report	10%
Poster Presentation	5%
First Reader Thesis Grade	40%
Second Reader Thesis Grad	30%
Oral Presentation	5%

Because CEE 478 is taken over two semesters, the grade received in CEE 478 counts as two grades in the departmental GPA.

Grading Basis for Faculty Advising Students in CEE 478 Senior Thesis in Civil and Environmental Engineering

A thesis with a grade of **A+** should contain original work, i.e. the project execution, analysis and interpretation, are largely the work of the student. The student devoted a large amount of time to the thesis and persevered to solve difficult problems on his/her own. The work is of high quality, with a creative approach, appropriate methods of analysis, and insightful interpretation. The background material is thoroughly researched, and includes examination of related societal issues. The thesis is complete and well written, and it is almost ready for publication (if that is the desire).

A thesis with a grade of **A- or A** should contain a large portion of original work, although some components of the work may have developed from suggestions of the advisor. The student devoted a large amount of time to the thesis and persevered to solve or overcome problems on his/her own or with the guidance of the advisor. The work is of high quality, with a creative approach, appropriate methods of analysis, and insightful interpretation. The background material is well researched, and includes examination of related societal issues. The thesis is complete and well written, and it will be ready for publication with a small amount of additional work (if that is the desire).

A thesis with a grade of **B-, B or B+** represents work from a student who worked independently but was advised extensively on the objectives and components of the project. The student worked steadily but did not solve or overcome problems on his/her own. The work is accurate but limited in scope. The conclusions derive correctly, but follow-up work would be needed to completely address the project objectives. The background material is researched and includes examination of related societal issues, but important references are missing. The thesis has all the components of a complete thesis, but is lacking in depth and originality.

A thesis with a grade of **C** represents work from a student that needed extensive help with the planning, execution and analysis of the project. The student worked sporadically and progress was seriously hindered due to lack of attention. The work is of questionable quality and would need to be repeated before definitive conclusions could be drawn. The subject has not been well researched and the thesis does not adequately examine related societal issues. The thesis is seriously lacking in scientific quality.

A thesis with a grade of **D** represents work from a student that devoted very little time and attention to the project. Large portions of the work were not completed. The work that was completed is of questionable quality and does not lead to useful conclusions. The subject has not been researched and the thesis does not examine related societal issues. The thesis is seriously lacking in virtually all aspects.

A thesis with a grade of **F** is largely incomplete and incorrect. The student worked rarely or not at all.