GRADUATE PROGRAM AND DEGREE REQUIREMENTS

Environmental Engineering

Effective Fall 2014

Master of Engineering (M.Eng.)
Master of Science (M.S.)
Doctor of Philosophy (Ph.D.)

Department of Civil and Environmental Engineering
The Pennsylvania State University
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TABLE OF CONTENTS

ENTRANCE REQUIREMENTS 3
Table 1. Minimum Entrance Requirements for all Applicants 3
PROFESSIONAL REGISTRATION 3
ADVANCED DEGREE PROGRAMS 4
Master of Engineering (M.Eng.) Degree 4
Course Work 4
Writing Portfolio 4
Master of Science (M.S.) Degree 4
Course Work 5
M.S. Advisory Committee 5
Thesis 5
Doctor of Philosophy (Ph.D.) Degree 5
Candidacy and English Examinations 5
Comprehensive Examinations 5
Final Oral Examination (Dissertation Defense) 5
PROGRAM REQUIREMENTS 6
Continuous Registration 6
Core Course Requirements 6
Table 2. Core Course Requirements 6
RESEARCH REQUIREMENTS 7
Areas of Specialization 7
Table 3. Courses applicable to core curriculum and areas of specialization 7
RESEARCH FACILITIES 8
Kappe Environmental Engineering Laboratories 8
Other Laboratories 9
Academic Computing 9
Research Centers and Institutes 9
GRADUATE FACULTY 10
Environmental Engineering Faculty 10
Water Resources Engineering Faculty 10

THE PENNSYLVANIA STATE UNIVERSITY
Department of Civil and Environmental Engineering

Graduate Program in Environmental Engineering

Entrance Requirements

While it is strongly recommended that an applicant possess an undergraduate degree from an accredited engineering program (e.g., civil, chemical, environmental, or mechanical), non-traditional students who possess an undergraduate degree in a related scientific field (e.g., chemistry, microbiology, geology, or environmental sciences) may be considered for admission subject to the provisions outlined below. Since admission into our graduate program is highly competitive, not all qualified applicants can be admitted. To be considered for admission, applicants should have at least a 3.0 junior/senior grade-point average (GPA); a GPA of 3.5 or higher is preferred for applicants from non-engineering backgrounds.

Depending on an applicant's educational background, it may be necessary to make up undergraduate course deficiencies. Students with non-traditional (non-engineering) backgrounds can be admitted on a *provisional basis,* pending completion of all undergraduate courses deficiencies. All students must meet the minimum entrance requirements listed below in Table 1. These courses must be included in the student's plan of study, however, none will count for graduate credit. Students may take these classes on a pass/fail or audit basis. Students may petition to use other related courses to satisfy these requirements or substitute work experience (for example in wastewater and water treatment). Students are encouraged to meet with their adviser to discuss these requirements.

Table 1. Minimum Entrance Requirements for all Applicants.

Course Topic	Penn State Course
Advanced mathematics typical of engineering undergraduate programs (calculus through partial differential equations)	MATH 140 Calculus With Analytic Geometry MATH 141 Calculus With Analytic Geometry II MATH 251 Ordinary & Partial Differential Equations
One lecture course and one laboratory course in chemistry	CHEM 012 Chemical Principles CHEM 014 Experimental Chemistry
One year of physics	PHYS 211 General Physics: Mechanics PHYS 212 General Physics: Electricity & Magnetism
One course in fluid hydraulics or mechanics	C E 360 Fluid Mechanics
One introductory course in environmental engineering	CE 370 Introduction to Environmental Engineering, *or* CE 371 Water and Wastewater Treatment

Professional Registration

All Environmental Engineering students are encouraged to take the Fundamentals of Engineering (FE) examination in preparation for engineering-design oriented careers leading to licensing via the Professional Engineer (PE) examination. In order to take the FE examination, students must possess a baccalaureate degree from an accredited engineering program.

Non-traditional students (i.e., without an accredited engineering degree) who wish to pursue FE certification

may wish to investigate the possibility of obtaining a baccalaureate degree in engineering first. (Please note that Penn State currently enforces an enrollment control that prohibits individuals who have a baccalaureate degree in any discipline to pursue a second baccalaureate degree in engineering at Penn State.) Students without an accredited baccalaureate degree in engineering may petition to take the FE exam, based on additional class work and other professional experience. These petitions have recently been successful in DE and OH, but not in PA. Course work that may be required in order to be eligible to take the FE examination include the following: 32 credits of math and basic sciences, 32 credits of engineering sciences, 16 credits of engineering design, and 16 credits of humanities and social science courses.

Advanced Degree Programs

The program in Environmental Engineering offers three advanced degrees: Master of Engineering (M.Eng.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.). A description of the general structure of our degree programs, as well as components unique to Environmental Engineering, follows.

Master of Engineering (M.Eng.) Degree

The M.Eng. degree is intended to be a professional degree composed of a well-balanced, unified, and complete program of study leading to advanced professional practice. Students must complete 30 credits of graduate course work, present a writing portfolio as described below, and satisfy the other academic program requirements outlined in this document. While full-time students could complete the program in two semesters, part-time students take longer. Students enrolled in an M.Eng. program are not considered for department support for research or teaching assistantships.

Course Work: A minimum of 30 graduate credits (400 level and above) is required, of which 20 must be earned at Penn State. At least 18 credits must be earned in the 500 series. Students are not permitted to count audited credits toward the minimum credits required for the degree.

Writing Portfolio: The submission of a writing portfolio is required for the M.Eng. degree. The writing portfolio should be developed with the adviser and may consist of the following types of writing samples: a semester paper, a report that documents a semester design project, an applied research paper, or professional papers. The writing sample must demonstrate in-depth knowledge of an engineering topic presented in a format typical of professional practice. The faculty adviser, with department head over-sight, shall review the portfolio to determine if the candidate has satisfied the writing skills requirement.

Students who have activated their intent to graduate must submit the approved writing portfolio to the department's Academic Programs Office, 218 Sackett Bldg, by the published *Master's Paper Draft Review Deadline.* The Academic Programs Office will certify receipt of the writing portfolio to Graduate Enrollment Services.

Master of Science (M.S.) Degree

The M.S. degree program is strongly oriented toward research. Students must complete 30 graduate credits, prepare a thesis, and satisfy the other academic program requirements outlined in this document. Typically, an M.S. degree takes one and a half years in residence to complete, assuming a summer is spent on thesis-related research. Often times a student will defend late in a semester following the completion of research and the thesis. For example, a student entering in a fall semester might defend in December of the following year, or January of the spring semester. In both cases, these dates are beyond the University's allowed completion date, so the student will officially be recognized at graduation ceremony in May. Students entering in the spring semester typically finish their studies during the summer of the following year and may attend graduation ceremonies in the summer or fall (December). Most employers will consider a student "graduated" when they have fulfilled all requirements (course and thesis) for the M.S. program, and thus the Universities official date of graduation generally does not affect employment status.

Course Work: A minimum of 30 graduate credits (400 level and above) is required, of which 20 must be earned at Penn State. At least 18 credits at the 500 and 600 level, combined, must be included in the program. A minimum of 12 credits of course work (400 and 500 level), as contrasted with research, must be completed in the *major* (courses prefixed CE). At least six credits must be devoted to the thesis (CE 600 or CE 610). Course work taken outside of the major area of emphasis can be used to satisfy the requirement of having 6 credits in a minor or general studies (i.e., outside of the major program of study). A formal minor program must meet the approval of the departments or committees responsible for both the major and minor fields.

M.S. Advisory Committee: The M.S. advisory committee shall consist of at least three members including the candidate's adviser and thesis supervisor, which are normally the same individual. One of the committee members may be from outside of the Department of Civil and Environmental Engineering. The student's adviser shall chair the advisory committee.

Thesis: The candidate's research topic must be approved by the advisory committee. The thesis is prepared under the supervision of the thesis adviser and advisory committee. An oral defense, which is open to the public, is required. The thesis must be submitted in accordance with the guidelines and deadlines established by the Graduate School. The Academic Programs Office must have a copy of the signature page submitted to the Thesis Office to keep in your file.

Doctor of Philosophy (Ph.D.) Degree

A student must first complete an M.S. degree before entering the Ph.D. program. A minimum of 21 credits of graduate course work (400 level and above) is required beyond the M.S. degree, or 15 credits beyond the M.S. in Environmental Engineering from Penn State. Students may petition to reduce the number of required credits based on professional experience or on unusual prior course work (such as two undergraduate degrees). Prior to completion of the Ph.D. program, the candidate must spend at least two consecutive semesters as a registered full-time student. While completion of the Ph.D. program ordinarily takes four years past the M.S. degree, the duration of the program varies from three to five years depending on the student's background and professional interests. Ph.D. candidates must successfully satisfy the following requirements indicated below.

Candidacy and English Examinations: Official status as a doctoral student is granted when the candidacy examination has been passed. The examinations are administered by the department and must be scheduled during the second semester after entering the program. Ph.D. candidates are required to demonstrate high-level competence in the core requirement topics. Ph.D. candidates are also required to demonstrate competence in the use of the English language, including reading, writing, listening, and speaking, to satisfy the language and communications skills requirements established by the department. Deficiencies are identified at the time of the candidacy examination, and students are directed into remedial work as appropriate.

Comprehensive Examinations: The Comprehensive Examinations (written and oral) should be scheduled during the first semester following completion of course work, excluding research credits. These examinations are administered by the (entire) doctoral committee and serve as an oral and written defense of the proposed dissertation research.

Final Oral Examination (Dissertation Defense): The final oral examination is normally not held until at least three months have elapsed after the Comprehensive Examination was passed. This oral examination is based mainly on the dissertation. A favorable vote of at least two-thirds of the doctoral committee is required for passing.

PLEASE NOTE: All exams must be scheduled in the department's Academic Programs Office.

Program Requirements

Graduate students in the Environmental Engineering program must meet with an adviser immediately after arriving on campus to begin their graduate studies. All graduate students, particularly M.S. degree candidates, should prepare a proposed plan of study which can be obtained in the Academic Programs Office. It is recommended that the study plan include information on the scheduling sequence in order to avoid potential scheduling conflicts during subsequent semesters. A Ph.D. candidate's course plan is considered to be more flexible since many students change course selections during the first year in order to align their research interests with the courses being offered.

The Environmental Engineering program is built upon a core of scientific and engineering knowledge, with specific courses (or their equivalent) required by all graduate students in the program. All students enrolled in the program must satisfy the continuous registration and the Core Course Requirements outlined in this document. In addition, all graduate students (M.Eng., M.S., and Ph.D) are encouraged to attend the weekly Environmental Engineering seminars that cover environmental engineering research and professional topics. These seminars also provide a good opportunity for students to practice and improve their technical presentation skills.

Continuous Registration

Graduate students must maintain continuous registration by scheduling at least one credit *each semester* from the date of admission until all degree requirements have been satisfied. Degree requirements have been satisfied when the student has completed the required course work and the student's writing portfolio, thesis, or dissertation has been approved by the department. Students accessing the resources of the University (i.e., faculty, facilities, etc.) during the summer must also register for the Summer Session. Students who fail to maintain continuous registration will be dropped from the program.

Core Course Requirements

Students select a program of study that satisfies the Core Course Requirements (Table 2) as well as an individually chosen area of specialization. Programs of study that satisfy the course requirements for each degree are developed in consultation with the adviser.

Table 2. Core Course Requirements. Students must demonstrate competence in each of the following four core areas: Biology, Chemistry, Chemical Transport, and Process Engineering (3 credits in each core area) from these suggested courses.

BIOLOGY	**CHEMISTRY**
CE 497x Environmental Microbiology Topics (2 cr.) *and* CE 479 Environmental Microbiology Laboratory (1 cr.) *or* CE 579 Environmental Pollution Microbiology (3 cr.)	CE 570 Environmental Aquatic Chemistry (3 cr.) *or* CE 573 Environmental Organic Chemistry (3 cr.)
PROCESS ENGINEERING	**CHEMICAL TRANSPORT**
CE 571 Physical-Chemical Treatment Processes (3 cr.) *or* CE 572 Biological Treatment Processes (3 cr.)	CE 576 Physical-Chemical Treatment Processes (3 cr.) *or* CE 580 Hydrodynamic Mixing Processes (3 cr.)

Research Requirements

Participation in independent research is required for the M.S. and Ph.D. degrees. The Environmental Engineering faculty undertake research requiring expertise in engineering, chemistry, microbiology, and computer modeling. Recently completed or ongoing investigations range from strictly fundamental concepts in water and wastewater treatment to mission-oriented research. Research areas include:

•activated carbon regeneration •adsorption, coagulation, and flocculation •bioenergy production •biological production of hydrogen •biogeochemistry of acid mine drainage •bioremediation of acid mine drainage •bioremediation of metals and radionuclides •bioremediation of organic contaminants •desalination •fluid mechanics and substrate transport in biofilms and microbial aggregates •microbial fuel cells •removal of trace contaminants using activated carbon •sorption and bioavailability of organic contaminants in soils and sediments •transport of colloids in porous media •use of ozone in water and wastewater treatment •waste minimization and pollution prevention

Students are encouraged to take courses outside of the environmental engineering specialty. Courses in geohydrology, geochemistry, agronomy, chemical engineering, chemistry, biotechnology, mineral processing, and materials science are of particular interest.

Table 3. Courses applicable to the core curriculum and areas of specialization.

C E 462	Open Channel Hydraulics
C E 465W	Water Resources Capstone Design
C E 472W	Environmental Engineering Capstone Design
C E 475	Water Quality Chemistry
C E 476	Solid and Hazardous Wastes
C E 479	Environmental Microbiology Laboratory
C E 497x	Environmental Microbiology Topics
C E 497y	Applied Field Methods in Environmental Engineering
C E 555	Groundwater Hydrology: Analysis & Modeling
C E 561	Fundamentals of Surface Hydrology
C E 562	Scaling Issues in Surface Hydrology
C E 566	Uncertainty & Reliability in Water Resources Engineering
C E 567	River Engineering
C E 570	Environmental Aquatic Chemistry
C E 571	Physical-Chemical Treatment Processes
C E 572	Biological Treatment Processes
C E 573	Environmental Organic Chemistry
C E 575	Industrial Waste Management
C E 576	Environmental Transport Processes
C E 578	Groundwater Remediation
C E 579	Environmental Pollution Microbiology
C E 580	Surface Water Quality Modeling
C E 591	Environmental Engineering Seminar
C E 592	Environmental Engineering Literature Topics
BIOL 415	Ecotoxicology
BIOL 435	Ecology of Lakes & Streams
B M B 400	Molecular Biology of the Gene
B M B 401	General Biochemistry
B M B 402	General Biochemistry
CH E 401	Chemical Process Engineering

Table 3. Courses applicable to the core curriculum and areas of specialization (continued).

CH E 414	Kinetics & Industrial Chemistry
CHEM 402	Chemistry in the Environment
CHEM 425	Chromatography & Electrochemistry
CHEM 426	Chemical Spectroscopy
CHEM 448	Surface Chemistry
EGEE 597A	Fundamentals of Electrochemistry
E R M 431	Environmental Toxicology
E R M 435	Limnology
E R M 447	Stream Restoration
E R M 450	Wetland Conservation
F SC 430	Air Pollutants From Combustion Sources
GEOSC 409W	Geomicrobiology
GEOSC 412	Water Resources Geochemistry
GEOSC 413	Techniques in Environmental Geochemistry
GEOSC 452	Introduction to Hydrogeology
ME 403	Polymer Electrolyte Fuel Cells
M E 405	Indoor Air Quality Engineering
M E 470	Fundamentals of Air Pollution
ME 497C	Dynamics of Energy Systems (
METEO 454	Introduction to Micrometeorology
MICRB 401	Microbial Physiology & Structure
MICRB 413	Microbial Diversity
MN PR 426	Aqueous Processing
MNG 445	Environmental Concerns in the Mining Industry
NUC E 420	Radiological Safety
NUC E 428	Radioactive Waste Control
SOILS 412W	Soil Ecology
SOILS 419	Soil Environmental Chemistry

Research Facilities

Kappe Environmental Engineering Laboratories

The Kappe Environmental Engineering Laboratories include the newly constructed 1,800 ft^2 BioEnergy Laboratory, part of the 9,800 ft^2 Kappe Environmental Engineering Laboratories on the University Park campus supervised by a laboratory manager (Mr. David Faulds). These laboratories include general research lab areas, dedicated microscopy and dark rooms, multiple temperature control rooms, and general-use rooms for instrumentation and preparations (http://www.engr.psu.edu/ce/kappe_lab.html). Major equipment available for this project includes: single-channel (Gamry Scientific) and multi-channel potentiostats; multimeters and computers for data acquisition; two microscopes equipped for phase contrast, epifluorescence, and DIC techniques with digital image capture and analysis capabilities; anaerobic glove boxes (3) for culture work; laminar flow hood for sterile culture transfers; respirometers for gas production measurement in batch or continuous flow bioreactors; bioreactors with pH and reactor flow control; gas chromatographs (4) for gas and volatile acids measurements; ion chromatographs (2) for measuring cations and anions in water samples; UV-vis spectrophotometers (2); a Total Organic Carbon/Total Nitrogen analyzer; a potentiostat; and numerous multi-channel multimeters and data acquisition systems. Other equipment available include: atomic force microscope (AFM); particle counters (3); high pressure liquid chromatograph (1): UV spectrophotometers (2); scintillation counter; atomic absorption spectrophotometer; computer-aided titrimeter; fluorimeter; Toxicity Analyzers (2); and various centrifuges, ovens, mutimeters, data acquisition systems, balances, freezers, and typical laboratory equipment.

Other Laboratories
Other research and teaching laboratories in the department include an engineering computation laboratory, structures laboratory, materials and soils laboratory, CAD laboratory, hydraulics laboratory, transportation laboratory, and the Bernard Hankin Construction Engineering and Management Research Laboratory. Most of these facilities are conveniently located in the Sackett and Hammond Buildings. Each laboratory is equipped with the standard equipment required for each specialty area. A recently commissioned Building Enclosure Test Facility serves both the Civil and Environmental Engineering and Architectural Engineering Departments.

Academic Computing
The Center for Academic Computing (CAC) provides a broad range of service and production facilities in support of Penn State's academic and research programs.

Computer laboratories are provided by CAC in over 30 locations on the University Park Campus. Computer training seminars, workshops, and open houses are available throughout the year. Students can purchase computer systems, peripherals, and software though Penn State's Microcomputer Order Center (MOC) at educational discount prices. Students can obtain an Access Account through CAC, which enables the use of electronic mail, Internet services, CAC labs, and the generation of personal web pages.

The Department of Civil and Environmental Engineering and the Center for Academic Computing jointly operate a PC facility. This laboratory is comprised of 25 IBM PC PC300GL computers with 32M memory, CD, sound, 15-inch monitors, and an extensive list of productivity and engineering software, including *Autocad* and *Mathematica*. The CAD laboratory has 30 work stations and two plotters. The Environmental Engineering graduate student laboratories and offices also contain many personal computers and software for data analysis, plotting, and word processing.

Research Centers and Institutes
Students studying civil or environmental engineering have access to numerous research resources and facilities on campus. Students may use the research facilities at the Applied Research Laboratory, the Center for Bioremediation and Detoxification, the Center for Geochemistry and Environmental Geochemistry, the College of Engineering's Environmental Institute, the H2E Center, Environmental Resources Research Institute, the Materials Research Laboratory, the Pennsylvania Housing Research Center, and the Pennsylvania Transportation Institute. In addition, the Agricultural Research Service (USDA) maintains the Northeast Watershed Research Center on campus.

Graduate Faculty

The Environmental Engineering program currently consists of seven faculty members from the Department of Civil and Environmental Engineering. Five additional faculty members specialize in the Hydrosystems emphasis within the Civil Engineering program. Further assistance is provided by faculty and staff from other departments in fields such as air pollution, incineration, hydrogeology, industrial engineering, geochemistry, economics, law, biochemistry, limnology and aquatic biology. Many of the participants in this program hold joint appointments through Penn State's Environmental Resources Research Institute.

Environmental Engineering Faculty

RACHEL A. BRENNAN, Ph.D. (Illinois), associate professor. In-situ bioremediation of soil and groundwater contaminants; physical, chemical, and biological treatment of acid mine drainage; chitin as a sustainable nutrient source for hazardous waste treatment; enzymatic biocatalysis of endocrine disruptors; molecular microbial ecology within remediation systems.

WILLIAM D. BURGOS, Ph.D. (Virginia Tech), professor. Bioremediation of soil, sediment and groundwater; biological iron(III) reduction; biological uranium(VI) reduction; biogeochemistry of Fe(II) and Mn(II) oxidation in coal mine drainage; contaminant interactions with natural organic matter.

FRED S. CANNON, Ph.D. (Illinois), P.E., professor. Water, air, and hazardous waste treatment; activated carbon, advanced oxidation, and surface chemistry; industrial pollution prevention.

CHRISTOPHER GORSKI, Ph.D. (University of Iowa), Assistant Professor. Contaminant fate in engineered and natural systems, aquatic geochemistry, environmental redox processes.

BRUCE E. LOGAN, Ph.D. (California, Berkeley), Kappe Professor of Environmental Engineering. Environmental and chemical transport processes; bioenergy production via biological hydrogen production and microbial fuel cells; Bioadhesion; bioremediation; particle coagulation, filtration and transport.

JOHN M. REGAN, Ph.D. (Wisconsin), P.E., associate professor. Biological processes with an emphasis on fermentative hydrogen production, nitrification, regrowth in drinking water distribution systems, molecular microbial ecology, and biofilm systems.

Water Resources Engineering Faculty

CHRISTOPHER J. DUFFY, Ph.D. (New Mexico Institute of Mining and Technology), P.H., professor. Stochastic and numerical modeling of groundwater flow and solute transport; modeling large-scale hydrologic systems.

PEGGY A. JOHNSON, Ph.D. (Maryland), professor, Department Head. Reliability and uncertainty analysis; river hydraulics; bridge scour; river restoration.

ALFONSO MEJIA, Ph.D. (Maryland, College Park), Assistant Professor. Hydrologic modeling for forecasting applications, urban ecohydrology, fluvial and river basin geomorphology, water resources engineering.

CHAOPENG SHEN, Ph.D. (Michigan State), assistant professor. Large scale hydrology, computational hydrology, land surface processes, water-carbon-nutrient interactions under global change, scale issues, subsurface reactive transport modeling, high performance computing.

MING XIAO, Ph.D. (Kansas State), associate Professor. Seepage and erosion (including surface and subsurface erosion, particle transport in porous media, and microscopic soil and pore fluid behaviors), geotechnical earthquake engineering, and geo-environmental engineering.

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Contents

PART I: INTRODUCTION 4
PROGRAM OVERVIEW 4
PROGRAM MISSION AND GOALS 4
DISTINCTIVE FEATURES AND PROGRAM EMPHASES 4
GRADUATE STUDIES AND RESEARCH 5
SUPPORT STAFF 5
FACULTY RESEARCH AREAS 6
Environmental Engineering 6
Geotechnical and Materials Engineering 6
Structural Engineering 7
Transportation Engineering 8
Water Resources Engineering 8
PART II: ADMISSION TO THE PROGRAM AND INITIAL PROGRESSION 9
ASSESSMENT CONSIDERATIONS 9
DEVELOPING A PLAN OF STUDY 9
STUDENT ACADEMIC SUPPORT 9
CHANGING ADVISORS 10
SARI REQUIREMENTS 10
SUPPORT SERVICES 10
PART III: GRADUATE SCHOOL DEGREE REQUIREMENTS 11
PART IV: MASTER OF ENGINEERING REQUIREMENTS 12
ADMISSION 12
CONTINUOUS REGISTRATION 12
ADVISOR/ADVANCED DEGREE COURSE PLAN 12
CREDIT REQUIREMENTS 12
PART V: MASTER OF SCIENCE REQUIREMENTS 14
ADMISSION 14
CONTINUOUS REGISTRATION 14
ACADEMIC ADVISOR/ADVANCED DEGREE COURSE PLAN 14
SELECTION OF THESIS SUPERVISOR 14
CREDIT REQUIREMENTS 14
ADVISORY COMMITTEE/THESIS PROPOSAL 15
ORAL EXAMINATION 16
PART VI: DOCTORAL REQUIREMENTS 17
CORE COURSEWORK 17
SPECIALIZATION COURSEWORK 17

CANDIDACY EXAMINATIONS 17
Written English Candidacy Examination 18
Written Candidacy Examination 18
Oral Candidacy Examination 18
DOCTORAL COMMITTEE AND COMPREHENSIVE EXAMINATION 19
The Doctoral Committee 19
Establishing the Doctoral Committee 20
Committee Responsibilities 20
Thesis Advisor 20
Minor Field Member 20
Replacing committee members 20
Comprehensive Examination 21
Preparation of the Thesis Proposal 21
Continuous Registration and Satisfactory Scholarship 22
CONDUCTING RESEARCH 22
WRITING AND DEFENDING THE DOCTORAL DISSERTATION 22
Writing Final Thesis Draft 22
Final Oral Examination Dissertation Defense 23
Scheduling the Final Oral Examination 23
Final Oral Examination Results 23
FINAL DISSERTATION DOCUMENT 24
GRADUATION 24
PART VII: APPENDICES AND ATTACHMENTS 25

PART I: INTRODUCTION

PROGRAM OVERVIEW

The Department of Civil and Environmental Engineering graduate program currently offers six graduate degrees: Master of Engineering (M.Eng.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) in either Civil Engineering or in Environmental Engineering. Each of these degrees requires the student to meet specific requirements of both the Pennsylvania State University Graduate School and the Department of Civil and Environmental Engineering (CEE). This handbook describes the departmental programs and requirements for each degree. This handbook is to be considered a supplement to the Graduate Degree Programs Bulletin. Students are advised to consult the Graduate Bulletin at: http://www.psu.edu/bulletins/whitebook for Graduate School degree requirements. Students should direct specific inquires with respect to the CEE graduate programs to the following:

Graduate Officer
Dr. William D. Burgos
115 Sackett Building
University Park, PA 16802
814-863-0578
bburgos@psu.edu

Graduate Staff Assistant
Ms. Judy Heltman
216 Sackett Building
University Park, PA 16802
814-863-3085
jheltman@engr.psu.edu

This handbook is divided into seven parts. Part I discusses the CEE graduate program mission and goals, distinctive features of the program and program emphasis areas, graduate studies and research support staff, faculty and areas of study. Part II discusses developing a Plan of Study, Academic support, and advisor and student responsibilities. Part III describes the Graduate School degree requirements. Part IV, V, and VI describe the graduate degree requirements for each of the programs. Part VII presents relevant appendices and attachments.

PROGRAM MISSION AND GOALS

The mission of the Department of Civil and Environmental Engineering is to prepare students for professional practice, graduate study, lifelong learning, societal leadership and to improve the scientific and technological basis for civil and environmental engineering practice. To fulfill this mission, the Department seeks to provide a high quality undergraduate program with instruction in all fundamental areas of civil engineering, to conduct a distinguished program of research and graduate study in selected areas of civil and environmental engineering, and to disseminate advanced technical knowledge to engineers, other professionals, and the public.

DISTINCTIVE FEATURES AND PROGRAM EMPHASES

The graduate programs at the Pennsylvania State University in Civil and Environmental Engineering consist of environmental engineering, geotechnical and materials engineering, structural engineering, transportation engineering, and water resources engineering. Over 30 faculty and full-time research personnel are actively involved in graduate instruction and research. Graduate enrollment in the past five years has averaged 102 master's students and 109 doctoral students. The research mission of the graduate program is supported by state of the art facilities located at Civil Infrastructure Testing and Evaluation Laboratory (CITEL), the Kappe environmental field station, and the Larson Transportation Institute test track, in addition to the geotechnical and other labs in the Sackett building. Several institutes and centers support research activities, particularly, the Larson Transportation Institute (LTI), the Pennsylvania Institute for Energy and Environment (PIEE), and the Pennsylvania Housing Research Center (PHRC).

GRADUATE STUDIES AND RESEARCH

The CEE Department offers graduate degrees in Civil Engineering and in Environmental Engineering. The master of engineering (M. Eng.) degree requires 30 credits of coursework and submission of a writing portfolio from coursework to demonstrate proficiency in report writing. The M. Eng. Degree is designed for students seeking an advanced degree to enter professional practice, and typically requires between one and two years of study. The master of science (M.S.) degree requires completion of 24 credits of coursework and a six-credit thesis, and is usually completed within two years. The M.S. degree is intended for students pursuing a research emphasis and seeking in-depth knowledge in an area within civil and environmental engineering. The M.S. degree requires completion of an original body of work resulting from research conducted by the student under the supervision of an advisory committee of graduate faculty members. Doctoral study is intended for students seeking in-depth knowledge in an area of civil and environmental engineering beyond that resulting from an M.S. degree, and who wish to pursue faculty positions, research positions in industry, state, or governmental institutions. Applicants with a B.S. may apply directly to the Ph.D. program; however, the faculty will determine eligibility for direct Ph.D. admission. Course requirements are currently being developed.

SUPPORT STAFF

The Graduate & Undergraduate Academic Programs Offices manage all Department of Civil and Environmental Engineering undergraduate programs, graduate programs, scholarships and fellowships, course and classroom scheduling, and web page administration. A computer systems technician and assistant provide IT support for the computer network and large number of computers operated within the department. A laboratory supervisor and technician are available to provide support for instruction and research in the departmental laboratories. Additional technical staff provides support for research conducted at other research laboratories housed outside the CEE Department. Additional staff supports the departmental central office and two research centers housed within the CEE Department.

Table 1.1: Department of Civil & Environmental Staff

LeAnn Anderson	Administrative Assistant	215A Sackett Bldg.
Amy Case	Staff Assistant	212 Sackett Bldg.
Tracy Dorman	PHRC Staff Assistant	219 Sackett Bldg.
David Faulds	Lab Supervisor	8B Sackett Bldg.
Heather Hamby	UG Staff Assistant	218 Sackett Bldg.
Matt Hassinger	Engineering Aide	8B Sackett Bldg.
Judy Heltman	Graduate Staff Assistant	216 Sackett Bldg.
Devon Johnson	Dept. Head Staff Assistant	212 Sackett Bldg.
David Jones	Research Support Assistant	125 Sackett Bldg.
Amy Long	Financial Assistant	212 Sackett Bldg.
Sarah K. Lowe	PHRC Admin. Assistant	219 Sackett Bldg.
Peg Van Ornum	Computer Support	206J Sackett Bldg.
Heather Weikel	Env. Staff Assistant	206L Sackett Bldg.
Bob White	Mgr. Network & IS	206F Sackett Bldg.

FACULTY RESEARCH AREAS

Environmental Engineering

The environmental engineering program includes faculty who specialize in the areas of water quality, water and wastewater treatment, environmental microbiology and chemistry, bioremediation, microbial fuel cells, treatment of solid and hazardous wastes, and green engineering. Research areas include microbial fuel cells, bioremediation, molecular biotechnology, activated carbon, acid mine drainage, and development of an Eco-Village.

Rachel A. Brennan, Associate Professor, 231K Sackett Bldg., rbrennan@engr.psu.edu, 814-865-9428.
In-situ bioremediation of soil and groundwater contaminants; molecular microbial community analysis; alternative nutrient sources for hazardous waste treatment.

William D. Burgos, Professor/Graduate Officer, 115 Sackett Bldg., bburgos@psu.edu, 814-863-0578.
Bioremediation of soil, sediment, groundwater; storm water pollution prevention; ecological risk assessment.

Fred S. Cannon, P.E., Professor, 225 Sackett Bldg., fcannon@psu.edu, 814-863-8754.
Water, air, and hazardous waste treatment; activated carbon and surface chemistry.

Christopher Gorski, Assistant Professor, 231F Sackett Bldg., cag981@engr.psu.edu, 814-865-5673.
Contaminant fate in engineered and natural systems, aquatic geochemistry, environmental redox chemistry.

Bruce E. Logan, Kappe Professor of Env. Engr., 231Q Sackett Bldg., blogan@psu.edu, 814-863-7908.
Environmental and chemical transport processes; bioremediation; biological wastewater treatment; fractal analysis of particles and coagulation processes; colloid transport in porous media.

John M. Regan, P.E., Professor, 231C Sackett Bldg., jregan@engr.psu.edu, 814-865-9436.
Biological nutrients removal, biological regrowth in drinking water distribution systems, molecular microbial ecology, biofilm systems.

Geotechnical and Materials Engineering

The geotechnical and materials engineering program focuses on classical geotechnical areas, geo-environmental, soil fabrics, use of geosynthetics for highway applications, and soil remediation. The pavement engineering program emphasizes advanced modeling of transportation materials, bituminous material characterization, pavement design and management, accelerated and full-scale pavement testing, pavement construction and rehabilitation, in addition to non-destructive testing, instrumentation, and monitoring.

Prasenjit Basu, Assistant Professor, 213C Sackett Bldg., pbasu@engr.psu.edu, 814-863-4010.
Computational geomechanics; foundation engineering; ground improvement techniques; soil structure interaction.

Tong Qiu, Assistant Professor, 226A Sackett Bldg., tqiu@engr.psu.edu, 814-863-7305.
Geotechnical engineering, soil dynamics, flow through porous media, fluid-solid interaction, unsaturated soil mechanics, numerical methods in geotechnical engineering.

Aleksandra Radlińska, Assistant Professor, 231D Sackett Bldg, ara@engr.psu.edu, 814-865-9427. Cement and concrete in sustainable design, alternative binders, construction materials with reduced CO2 emission, durability, shrinkage, cracking of concrete, reliability-based analysis of the behavior of construction materials.

Farshad Rajabipour, Assistant Professor, 231M Sackett Bldg., Farshad@engr.psu.edu, 814-863-0601. Concrete materials, durability, alkali-silica reaction, waste utilization in development of green cements, mass transport in cracked concrete.

Shelley M. Stoffels, P.E., Associate Professor, 208 Sackett Bldg., sms26@engr.psu.edu, 814-865-7254. Pavement design, materials, analysis, and rehabilitation; infrastructure management; geotechnical engineering; engineering economics; professional practice issues.

Ming Xiao, Associate Professor, 231P Sackett Bldg., mxiao@engr.psu.edu. 814-867-0044.
Seepage and erosion (including surface and subsurface erosion, particle transport in porous media, and microscopic soil and pore fluid behaviors), geotechnical earthquake engineering, and geo-environmental engineering.

Structural Engineering

Faculty in the structural engineering graduate program offer courses in analysis and design of structures with special emphasis on bridge design. The faculty is engaged in research in bridge behavior, bridge construction, bridge materials, bridge design, concrete structures, and advanced materials applications.

Swagata Banerjee Basu, Assistant Professor, 221B Sackett Bldg., swagata@engr.psu.edu, 814-863-2936. Earthquake engineering; structural reliability; uncertainty quantification; bridge engineering; risk assessment of civil infrastructure systems under natural hazards.

Jeffrey A. Laman, P.E., Professor, 231J Sackett Bldg., jlaman@psu.edu, 814-863-0523.
Bridge evaluation, testing and dynamics; long-term structural monitoring; fatigue; optical fiber sensor design; structural reliability methods; steel design.

Maria M. Lopez de Murphy, Associate Professor, 231E Sackett Bldg., mmlopez@engr.psu.edu, 814-865-9423. Interfacial bond behavior between epoxy bonded Fiber Reinforced Polymeric (FRP) laminates and concrete; FRP bridge deck systems.

Ali Memari, Hankin Chair and Director of PHRC, 222 Sackett Bldg., amm7@psu.edu, 814-863-9788.
Single-family and multi-family building design and construction, experimental and analytical evaluation of light-frame, masonry, and panelized wall systems for commercial and residential building, seismic testing and evaluation of various types of glazing systems.

Andrew Scanlon, S.E., Professor, 220 Sackett Bldg., axs21@psu.edu, 814-867-0151.
Safety and serviceability of concrete structures; analytical modeling of concrete structures; structural dynamics; earthqueake engineering; bridge engineering.

Gordon Warn, Assistant Professor, 226B Sackett Bldg., gwarn@engr.psu.edu, 814-863-2786.
Seismic protective systems; structural dynamics; analytical modeling of structural resilience; structural health monitoring.

Transportation Engineering

Transportation engineering faculty covers the areas of transportation planning, design, and operations. Research areas include traffic operations, systems planning for freight, transit and non-motorized travel, travel behavior, transportation planning for emergency response and climate change related issues, infrastructure financing and programming, transportation safety highway design and performance measures, intelligent transportation systems, human factors and driver behavior, pavement marking materials, statistical and econometric analysis of transportation systems, environmental and ecological aspects of transportation network design, and urban simulation.

Eric T. Donnell, Associate Professor, 231N Sackett Bldg., edonnell@engr.psu.edu, 814-863-7053.
Highway geometric design and highway safety; intelligent transportation systems; and computer-aided design applications.

Vikash Gayah, Assistant Professor, 231L Sackett Bldg., gayah@engr.psu.edu, 814-865-4014.
Traffic flow theory, traffic operations, transportation network modeling, public transportation systems, urban mobility.

Martin T. Pietrucha, P.E., Professor, 221 Sackett Bldg., mtp5@psu.edu, 814-863-7306.
Highway safety; operational effects of highway geometrics; alternative transportation strategies.

Venkataraman N. Shankar, Professor, 226C Sackett Bldg., shankarv@engr.psu.edu, 814-865-9434. Statistical and econometric methods in transportation systems, intelligent transportation systems; travel behavior and transportation planning; safety; infrastructure assessment, urban simulation and environmental implications in transportation networks.

Water Resources Engineering

Water Resources Engineering faculty work in the areas of hydraulics, hydrology, water resource management, fluid mechanics, and wave mechanics. Research areas include watershed management, river hydraulics, climate and environmental change impacts on water security, hydroinformatics, hydrologic modeling, uncertainty and reliability, and fundamental aspects of wave mechanics.

Christopher J. Duffy, P.H., Professor, 231G Sackett Bldg., cxd11@psu.edu, 814-863-4384.
Stochastic and numerical modeling of groundwater flow and solute transport; modeling large-scale hydrologic systems; dynamical systems.

Peggy A. Johnson, Professor and Department Head, 212 Sackett Bldg., paj6@psu.edu, 814-865-1330. Reliability and uncertainty analysis; river hydraulics; bridge scour; river restoration.

Xiaofeng Liu, Assistant Professor, 223B Sackett Bldg., xliu@engr.psu.edu, 814-863-2940. Computational fluid dynamics (CFD), environmental fluid mechanics, sediment transport and erosion control, land surface process and morphodynamics, multiphase flow, water quality modeling.

Alfonso Mejia, Assistant Professor, 215B Sackett Bldg., amejia@engr.psu.edu, 814-865-0639.
Computer and mathematical modeling of hydrologic related processes and phenomena, urban ecohydrology, fluvial and river basin geomorphology, sustainable water resources.

Chaopeng Shen, Assistant Professor, 206C Sackett Bldg., cshen@engr.psu.edu, 814-863-5844.
Large scale hydrology, computational hydrology, land surface processes, water-carbon-nutrient interactions under global change, scale issues, subsurface reactive transport modeling, high performance computing.

PART II: ADMISSION TO THE PROGRAM AND INITIAL PROGRESSION

ASSESSMENT CONSIDERATIONS

Additional admissions information is available at the Graduate School website: http://www.psu.edu/bulletins/whitebook/$aap.htm. The Pennsylvania State University is committed to an equal access policy for all persons, assuring equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Direct all inquiries regarding the nondiscrimination policy to:

Affirmative Action Director
The Pennsylvania State University
201 Willard Building
University Park, Pa 16802-2801
Tel (814) 865-4700/V
(814) 863-1150/TTY.

DEVELOPING A PLAN OF STUDY

All CEE graduate students are required to develop a different *Plan of Study* for M. Eng, M.S. and Ph.D. degrees early in the program, preferably by the end of the second semester and no later than the end of the third semester of study. In developing the Plan, students are assisted by their academic advisor. Doctoral students must submit a *Plan of Study* at the time of the Candidacy Exam. In addition, doctoral students must specialize in a specific area within the field of civil and environmental engineering, develop in-depth understanding of research methods suitable to their area of specialization, and conduct an independent and original research study – the dissertation. Master's and doctoral students are expected to develop a broad knowledge of the field of CEE, as well as a general knowledge of research designs and methods, demonstrating the suitability of designs and methods for the thesis or dissertation. Requirements for each of the graduate degrees are specified in this handbook.

STUDENT ACADEMIC SUPPORT

Upon admission to the CEE graduate program, students are assigned an interim academic advisor by the program coordinator. The eventual advisor will be based on mutual career and research interests of the student and faculty. All academic advisors are full-time CEE faculty with Graduate Faculty status.

Advisor and student responsibilities

The academic advisor acts as the student's primary academic and career mentor at Penn State. The advisor's primary responsibilities are: (1) to assist in the development of a *Plan of Study* depending on degree; (2) to advise on and approve of course(s) election each semester; (3) to advise on, and assist in preparing the student for the candidacy and comprehensive examinations (Ph.D.); (4) to assist with professional development activities (internships, attending and presenting at conferences, authorship and co-authorship of journal articles

and book chapters, developing teaching portfolios, etc.) that would enhance academic preparedness and career prospects; and (5) to serve as the chair (or co-chair) of the student's doctoral committee.
Communication between the graduate student, the advisor, and if applicable, the thesis committee is a key factor in the progression through the graduate program. It is the student's responsibility to consult with her/his advisor and committee regularly throughout the course of study. Contact may be made by telephone, e-mail, or in person by appointment.

CHANGING ADVISORS

A student may change her/his academic advisor. Either the student or the academic advisor may suggest this change. Proposed changes should be discussed between the affected parties prior to any official action. An advisor change must be made with the consent of the student, the new advisor, and the current advisor. Notification will need to be made to the Graduate Assistant in the Academic Programs office, 216 Sackett.

SARI REQUIREMENTS

Starting with the fall 2009 incoming class, all new, and continuing from the M.S. degree to a Ph.D. degree students must complete SARI (Scholarship and Research Integrity) requirements.

The SARI program at Penn State is designed to offer graduate students comprehensive, multilevel training in the responsible conduct of research (RCR), through a two-part program: an online course to be completed in the first semester of graduate study, followed by five hours of discussion-based RCR education prior to degree completion. Two hours of Office of Research Protection (ORP) seminars and three hours of College or Departmental seminars. To complete the College or Departmental seminars, students may register CE 590 through the Academic Programs Office in 216 Sackett Building.

SUPPORT SERVICES

The University provides numerous resources and services to support prospective adult students considering graduate studies, and currently enrolled adult students.

The Center for Adult Learner Services (CALS) provides assistance to adult students who wish to improve their skills in areas such as computers, math, and writing. Detailed information about CALS is located at: http://www.sa.psu.edu/cals/about.shtml.

The Graduate Student Association (GSA) provides graduate students with information on topics such as taxes and health care options, babysitters and typists/editors. Detailed information about GSA is located at: http://www.clubs.psu.edu/up/gsa/.

The Work/Life Programs provides quality childcare program information and services for students with a family. Descriptions of the programs offered are available at Work/Life website: http://www.ohr.psu.edu/worklife/index.htm.

The Center for Women Students (CWS) assists women facing issues related to sex-based discrimination or harassment. More information on the CWS is located at: http://www.sa.psu.edu/cws/.

The Women in Engineering program information is located at: http://www.engr.psu.edu/wep/
Information pertaining to other student services such as Career Services, Counseling and Psychological Services, Disability Services, Office of Graduate Educational Equity, Health Insurance and University Health

Services, International Student Services, Kern Graduate Commons and Veterans Outreach Office are available on the Graduate School website: http://www.psu.edu/bulletins/whitebook/$services.htm.

PART III: GRADUATE SCHOOL DEGREE REQUIREMENTS

The Pennsylvania State University Graduate School publishes minimum requirements for all graduate degrees awarded by the University. Additional graduate degree requirements are established by the College of Engineering, the Department of Civil and Environmental Engineering, and programs within CEE. Graduate School graduate degree requirements are published on the Graduate School website in the Graduate Degree Bulletin at:

http://www.psu.edu/bulletins/whitebook/$gradreqs.htm

The published Bulletin contains comprehensive Penn State University Graduate School requirements that must be met by M. Eng., M.S., and Ph.D. students to complete the respective degree. It is the responsibility of the student to read, understand, and discuss these requirements with her/his academic advisor, and if applicable, thesis advisor. The Penn State University Graduate School graduate degree requirements supersede any conflicting requirements.

In summary, the Penn State University Graduate School requirements address issues related to the following:

M.Eng. & M.S. specific requirements:

- minimum grade-point average required for graduation
- maintaining good academic standing
- M. Eng. time limitation
- M.S. time limitation
- advanced standing and transfer credits

Ph.D. specific requirements:

- general requirements
- time limitation to complete the program
- off campus and transfer credit
- advisors and doctoral committees
- English competence
- candidacy, comprehensive, and final examination
- thesis acceptance
- residence requirements
- continuous registration requirements

SARI (Scholarship and Research Integrity) requirements

- Online CITI Exam (completed the first year of study)
- 5 hours of seminars (2 hrs of ORP seminars and 3 hrs of COE/Department seminars)

The above summary is not exhaustive and does not include Departmental and program requirements that may be in addition to the Graduate School requirements. All graduate students in the Department of Civil and Environmental Engineering are strongly encouraged to familiarize themselves with all Graduate School degree requirements.

PART IV: MASTER OF ENGINEERING REQUIREMENTS

The following policies and procedures have been adopted by the Department of Civil and Environmental Engineering to supplement the *Procedures and Regulations* contained in the *Graduate Degree Programs Bulletin*. These requirements apply to all Master of Engineering (M. Eng.) degree candidates in the fields of Civil Engineering and Environmental Engineering.

ADMISSION

Requirements for admission are stated in the *Graduate Degree Programs Bulletin*. All graduate students intending to pursue an M. Eng. degree must enroll as a regular graduate student. Prior to the start of classes, each student is advised to confer with the respective program coordinator for general counseling and advising.

CONTINUOUS REGISTRATION

Applicants admitted to the Civil or Environmental Engineering graduate programs must maintain continuous registration by registering for at least one credit each semester from the date of admission until all degree requirements have been satisfied. Degree requirements have been satisfied when the student has completed the required course work and the writing portfolio has been approved by the student's advisor and department head. Students utilizing the resources of the University (i.e., faculty, facilities, etc.) during the summer must also register for the summer session.

ADVISOR/ADVANCED DEGREE COURSE PLAN

The general guidance of an M.Eng. degree candidate is the responsibility of the advisor who will be recommended by the program coordinator. The advisor will assist the student in planning a program of study. An *Advanced Degree Course Plan* should be approved by the student's academic advisor and the Graduate Officer during the first four weeks of enrollment in the program. The *Advanced Degree Course Plan* must be completed by the end of the first semester and located in the Academic Programs office, 216 Sackett.

CREDIT REQUIREMENTS

The M. Eng. degree provides education and the theoretical basis for advanced professional practice. A minimum of thirty graduate credits (400 level and above) of course work and a writing portfolio are required. Twenty out of the thirty required credits must be earned at an established graduate campus of Penn State University. At least eighteen credits must be earned in 500-level courses. In addition, programs within Civil and Environmental Engineering may list specific core courses required for graduation. Audited credits may not be applied toward the minimum credits required for the degree.

WRITING PORTFOLIO

The M. Eng. degree is intended to be a professional degree composed of a well-balanced, unified, and complete program of study. As such, a writing portfolio must be submitted to meet graduation requirements. The writing product, or products, may consist of a semester paper, a report that documents a semester design project, a synthesis of research (applied research), or professional papers. The writing product(s) must reflect the candidate's ability to describe a culminating event that is typical of professional practice. The faculty advisor, with department head oversight, shall review the portfolio to determine if the candidate has satisfied the writing skills requirement. Students who have activated their intent to graduate must submit an approved writing

portfolio to the Graduate Academic Programs Office by the published master's paper draft review deadline. The Graduate Academic Programs Office must certify receipt of writing portfolios to the Graduate School so that the student may proceed to graduation.

Time Schedule

The following summarizes the various requirements that must be met by the student:

Upon admission:	Confer with the respective program coordinator who will recommend an advisor to formulate a plan of study.
In first 4 weeks of first semester but, no later than the end of the first semester:	Submit proposed *Advanced Degree Course Plan* for approval of the academic advisor and the Graduate Officer.
During published period:	Activate intent to graduate on Elion
By published master's paper draft review deadline:	Submit approved writing portfolio to the Academic Programs Office.
Final Certification:	Students who have completed all of the requirements for the degree will be approved for graduation.

PART V: MASTER OF SCIENCE REQUIREMENTS

The following policies and procedures have been adopted by the Department of Civil and Environmental Engineering to supplement the *Procedures and Regulations* contained in the *Graduate Degree Programs Bulletin*. These requirements apply to all Master of Science (M.S.) degree candidates in the fields of Civil Engineering and Environmental Engineering.

ADMISSION

Requirements for admission are stated in the *Graduate Degree Programs Bulletin*. A student planning to pursue an M.S. degree must enroll as a regular graduate student and upon arrival shall confer with the program coordinator within the desired specialty area for general counseling and advising.

CONTINUOUS REGISTRATION

The master of science degree is designed to be completed in 3 or 4 semesters. Master of science students admitted to civil or environmental engineering must maintain continuous registration by enrolling for at least one credit each semester from the date of admission until all degree requirements have been satisfied. Degree requirements have been satisfied when the student has completed the required course work and the thesis has been approved by the advisor, the thesis committee, and the Department Head. Students accessing the resources of the University during the summer must also register for the summer session.

ACADEMIC ADVISOR/ADVANCED DEGREE COURSE PLAN

The general guidance of a master's degree candidate is the responsibility of the academic advisor through mutual agreement with the student. The advisor's role is to assist the student in planning a program of study. An *Advanced Degree Course Plan* should be approved by the student's academic advisor and the Graduate Officer during the first 4 weeks of enrollment in the program. The *Advanced Degree Course Plan* must be completed by the end of the first semester.

SELECTION OF THESIS SUPERVISOR

The academic advisor will normally also serve as the thesis supervisor. However, upon recommendation of the academic advisor, another graduate faculty member may be appointed to supervise the candidate's thesis. The thesis supervisor will recommend coursework supporting the research program, oversee the conduct of the research program and supervise the development of the master's thesis.

CREDIT REQUIREMENTS

The master of science degree program is strongly oriented toward research. A minimum of thirty graduate credits is required, of which twenty must be earned at an established graduate campus of the Pennsylvania State University. A minimum of eighteen credits in the 500 and 600 series, combined, must be included in the course program. A minimum of twelve credits in course work (400 and 500 series), as contrasted with research, must be completed in the major program (courses prefixed CE). Programs within the CEE Department typically require specific core courses. Courses enrolled as an audit may not be applied toward the minimum thirty credits required for the master of science degree. A thesis is required, and at least six credits of thesis research (CE 600 or 610) must be included in the candidate's academic course plan.

Course work taken outside the major program area of emphasis can be used to satisfy the minimum of six credits in a minor or general study. A minor program must meet the approval of the departments or committees responsible for both the major and minor fields. Completion of a graduate minor is not a requirement for the M.S. degree.

The master of science thesis should explore new ideas and techniques. Thus, the research topic is expected to include findings that bring new insight and knowledge to a given problem area. Emphasis should be placed on the generalization of research findings and overall transferability to engineering problems.

Students must follow the *Thesis Guide* for the development and formatting of the master thesis, which can be obtained at: http://www.gradsch.psu.edu/thesis/contents.html. This publication contains information regarding format, paper, illustrations, etc.

Students who have activated their intent to graduate must submit a draft (no signatures required) of their thesis to the Graduate School Thesis Office by the published thesis format review deadline. Candidates whose theses have been approved by the Department must provide one signed, unbound copy to the Thesis Office by the published thesis final submission deadline. A final copy of the thesis must also be provided to the advisor and committee members as requested upon completion of the program.

ADVISORY COMMITTEE/THESIS PROPOSAL

When the student is ready to begin working on the thesis, an advisory committee must be appointed by the Graduate Officer in consultation with the student's advisor. Normally the advisory committee is appointed near the end of the first semester of study. The advisory committee consists of a minimum of three members of the graduate faculty, including the candidate's advisor and thesis supervisor. When appropriate, one of the committee members may be from outside the Department of Civil and Environmental Engineering. The student's thesis supervisor chairs the advisory committee. The Graduate Academic Programs Office must be notified as soon as the committee is formed so that committee members can be officially recorded and notified.

The advisory committee is responsible for:

(a) approving the thesis topic,
(b) monitoring the research progress,
(c) reviewing the final draft of the thesis prior to the oral examination, and
(d) conducting the oral examination of the candidate.

The official initiation of the thesis and research begins with a proposal meeting that includes the advisory committee and the candidate. The meeting is to take place early in the second semester of study. The proposal meeting should include a discussion of the research topic, research plan, and anticipated results of the research to allow a determination of the research program suitability. Normally the thesis proposal will consist of background, motivation, problem statement, scope, objectives, an initial literature review, research approach, preliminary results, and anticipated results. The proposal meeting typically consists of a 20 to 30 minute presentation of the proposal with approximately one hour of discussion, as needed. The thesis proposal document should be distributed to the advisory committee members no less than one week prior to the thesis proposal meeting.

Based on the oral examination, the advisory committee and the thesis supervisor will convey to the student its majority recommendation that may include:

(a) approval of the thesis,
(b) conditional approval, pending completion of revisions,
(c) or rejection of the thesis.

The final thesis must meet the approval of the Department Head, in whom the Graduate Faculty of the department has vested the responsibility to ensure that all theses conform to established standards and that the thesis supervisor and advisory committee have fulfilled all obligations with regard to the thesis. In addition, the thesis must be approved by the Graduate School Thesis Office.

ORAL EXAMINATION

Every master of science degree candidate must undergo a public oral examination before the advisory committee. The candidate is responsible for scheduling the examination (date, time, and place) and informing the Graduate Academic Programs Office staff of the arrangements, as well as the title of the thesis. A notice announcing the defense will be posted for all faculty, graduate students, and interested members of the public. The candidate is expected to summarize the research in a presentation that will include:

(a) a statement of the problem,
(b) the motivation and justification for the research (i.e., relative importance of the subject to the profession),
(c) a statement of research objectives,
(d) a distinction between the contribution that originates from the candidate and that which has been taken from other sources,
(e) a concise presentation of the research methodologies,
(f) a presentation of key research results,
(g) interpretation of the results, and
(h) conclusions that are based on the research findings.

The candidate should expect to defend the research at the conclusion of the presentation and should be prepared to defend any portion of the thesis. Typically there will be a period of questioning open to the general public followed by a closed meeting with the advisory committee.

Time Schedule

Upon admission:	Confer with the respective program coordinator, who will recommend an advisor to formulate a plan of study.
No later than the end of the first semester:	Submit proposed *Advanced Degree Course Plan* for approval by the academic advisor and the Graduate Officer.
No later than the tenth week of the second semester:	Appointment of advisory committee and approval of thesis proposal.
During published period:	Activate intent to graduate on E Lion
By published thesis format review deadline:	Submit a complete draft (no signatures required) to the Graduate School Thesis Office (115 Kern Building).
Two weeks prior to the thesis defense:	Provide a copy of the final draft to each advisory committee member.
Not less than two weeks following submission of the final draft:	Oral examination (thesis defense).
By published thesis final submission deadline:	Submit final, corrected, signed copy of thesis to the Thesis Office. In addition, copies must also be provided to the thesis advisor and committee members as requested.
Final Certification:	Students who have completed all of the requirements for the degree will be approved for graduation.

PART VI: DOCTORAL REQUIREMENTS

The requirements presented here have been adopted by the Graduate Faculty of the Department of Civil and Environmental Engineering and supplement the Pennsylvania State University Graduate School graduate degree requirements as stated in the *Graduate Degree Programs Bulletin*. All Ph.D. degree candidates in the Department of Civil and Environmental Engineering are responsible for complying with the requirements in this document, the *Graduate Degree Programs Bulletin:*

http://www.psu.edu/bulletins/whitebook/$gradreqs.htm

and the *Thesis Guide*:

http://www.gradsch.psu.edu/current/thesis.html

The doctor of philosophy degree program is normally completed in four to five years by full-time students. However, time to complete the degree varies depending on individual effort and success in research and writing. The doctoral degree program consists of six stages: 1) core course work; 2) course work related to an area of specialization; 3) candidacy and English competency examinations; 4) naming of the doctoral committee and the comprehensive examinations; 5) research activities; and 6) writing and defending the doctoral dissertation.

CORE COURSEWORK

In the first stage of the doctoral program, students meet core course requirements for the program and broaden and deepen knowledge within the chosen focus area of civil engineering. While completing core coursework, students will identify a faculty academic advisor and begin to narrow their research focus. In most cases the student and advisor will have been in contact prior to admission to the program and research activity will be initiated within the first semester. Each student must discuss program core course requirements with their academic advisor as well as course selection to prepare for the candidacy examinations.

SPECIALIZATION COURSEWORK

As the doctoral student narrows the research focus, additional coursework may be recommended by the academic advisor in support of the research topic.

CANDIDACY EXAMINATIONS

The candidacy examination has three purposes: 1) to determine the compatibility between the student's academic and professional aspirations and the graduate program goals; 2) to assess the student's competence in areas critical to completion of the dissertation, including communication skills of writing, critical thinking, and conduct of research; and 3) to confirm that the student should continue in the CEE Ph.D. program.

The candidacy examinations should be taken during the second semester of study, however, must be taken within three semesters (summer sessions do not count) of entry into the doctoral program. Candidacy examination requests must be formally submitted to the Graduate Academic Programs Office no less than three weeks prior to the scheduled examination. The CEE Academic Programs Office will submit the examination results to the Graduate School for approval and recording. To be eligible for each of the three candidacy examinations the student must meet the following criteria:

1. have a minimum grade-point average of 3.00 at the time the examination is given, for graduate work done at Penn State.
2. have no deferred grades, missing grades, or exceed 12 quality graded research credits.
3. complete at least 18 credits earned beyond the bachelor of science.
4. be registered during the semester the examinations are administered, including summer.

The candidacy committee is appointed by the Professor-in-Charge of the Graduate Program upon recommendation of the academic adviser, who serves as chair of the candidacy committee. The committee consists of at least five members of the Graduate Faculty, including at least three members from the candidate's major program area.

Written English Candidacy Examination

The written English candidacy examination is administered and evaluated by the candidacy committee. The English examination consists of a candidate response in the form of a concisely written 3-to 5-page essay (600 to 1000 words) on a topic selected by the committee. The written English examination will be administered no more than two weeks prior to the written candidacy examination. The examination is evaluated on the basis of syntax, grammar, spelling, and organization. If the candidate is unable to meet committee expectations for written English, one appeal for re-examination may be honored at the discretion of the candidacy committee.

Students who fail the written English candidacy examination must complete an English writing course, such as ENGL 198G (Writing in the Disciplines) or ENGL 418 (Advanced Technical Writing and Editing). International students may schedule SPCOM 116G ESL (Reading and Writing). A grade of "B" or better must be achieved for the candidate to satisfy the written English requirement. Candidates are permitted to complete remedial English writing courses a maximum of two times.

Written Candidacy Examination

The written candidacy examination is designed to test the candidate's retained knowledge from previous and current course work. The chair of the candidacy committee will solicit examination questions from each of the candidacy committee members covering specific areas of competence. The committee will determine the final composition of the written candidacy exam in cooperation with the committee chair. The candidate must successfully complete the written candidacy in order to continue to the oral candidacy examination. The oral candidacy examination should be conducted within the 5 days following the written candidacy examination, but no later than 2 weeks after the written examination.

Oral Candidacy Examination

The oral candidacy examination consists of a short oral presentation by the candidate followed by committee questions related to the presentation and the written candidacy examination. The oral candidacy examination will normally be 2 hours in length. The oral presentation duration is normally 20 minutes in the style of a conference presentation. The topic is determined by the candidate in consultation with the advisor. Committee evaluation of the presentation is conducted on the basis of organizational structure, delivery, and use of visual aids. The oral examination will continue with committee questions on the subject of the oral presentation. The primary focus of committee questions following the oral examination will be the subject material of the written candidacy examination and other important areas of required competence.

The candidacy committee may require candidates to enroll in SPCOM 114G (Basic ESL) to improve speaking competency and achieve a grade of "B" or better. Candidates may take remedial speaking courses a maximum of two times to meet this requirement.

Candidacy Examination Results

The candidacy committee will meet to formulate a final, overall candidacy performance decision within one week of the oral candidacy examination. A favorable vote of at least two-thirds of the committee is required for passing both the oral and written components of the English and candidacy examinations. The committee may require the candidate to schedule courses to remediate academic and language deficiencies that were discovered during the candidacy examinations. Immediately following the candidacy committee meeting, the committee will meet with the candidate to discuss the results. The results will take the form of one of the three following:

1. Admit student to candidacy for the Ph.D. degree. From this point on the student will take the coursework outlined in the "PhD Plan of Study", as amended by the candidacy committee and begin preparing for the comprehensive examination. This is the date set to begin the eight year time limitation to complete the degree.
2. Postpone a candidacy decision until further conditions are met. These conditions may include additional technical course work or remedial writing or speaking course work as described under the written English and oral candidacy examinations above. The program committee will set forth all further conditions in writing to the candidate and file them with the Graduate Academic Programs office.
3. Do not admit student to candidacy. If this option is selected, alternative steps that may help the student achieve her/his academic and professional goals will be discussed prior to adjournment. If the candidate fails the oral candidacy examination, one appeal for re-examination may be honored at the discretion of the candidacy committee.

The chair of the candidacy committee shall forward the decisions, using the departmental grading form and the Graduate School "Report on Doctoral Candidacy" form to the Academic Programs office, 216 Sackett. The student becomes an official doctoral candidate only when positive candidacy examination results are recorded by the Graduate School.

DOCTORAL COMMITTEE AND COMPREHENSIVE EXAMINATION

This stage begins with the formation of a doctoral committee and culminates with a comprehensive examination. Following successful completion of the candidacy examinations and formation of the doctoral committee, the candidate conducts an in-depth exploration of a chosen area of study. During this stage, the candidate sharpens the subject and focus of the research undertaking, and develops theoretical frameworks/perspectives, and research methods and techniques suitable for studying a wide range of problems associated with the area of specialization. This is a highly individualized phase with candidates pursuing interests that are representative of faculty expertise, of the broader field of engineering, and with the potential for original contribution to the scientific area of inquiry.

The Doctoral Committee

The candidate should carefully select a doctoral committee as soon as possible, but no more than six months after successfully completing the candidacy examinations. Upon notification from candidate's academic advisor, the Department Head will recommend the candidate's doctoral committee to the Graduate School. Upon approval of the doctoral committee by the Graduate School, the committee will be recorded. The chair of the doctoral committee is also the student's permanent academic and thesis advisor and will, along with the doctoral committee, provide overall guidance for the candidate's doctoral program. The committee will direct

the candidate in the preparation of the research proposal, conduct of the research, and the development and defense of the thesis. Doctoral committee members should bring different but complementary strengths to the candidate's research program. The candidate is advised to choose individuals who can provide expertise in the chosen area(s) of specialization, the general field of engineering, and the research methods specific to the dissertation.

Establishing the Doctoral Committee

The doctoral committee comprises at least four Graduate Faculty members:

- two members from the CEE Department; at least one from the campus at which the student is enrolled,
- one member from outside the CEE Department who has neither fiscal nor publication connection to the student's research. This member is referred to as the "Outside Field Member", and
- at least one member that is outside the unit in which the dissertation advisor's primary appointment is held. This committee member is referred to as the "Outside Unit Member".
- If the candidate has a minor, that field must be represented on the committee by a "Minor Field Member."

Students must formally request a doctoral committee appointment from the CEE Graduate Programs Office within six months of passing the candidacy examinations. The doctoral committee request is then forwarded by the Graduate Academic Programs office to the Graduate School for approval and recording. Additional specific doctoral committee composition requirements are presented in the *Graduate Degree Programs Bulletin*, found at: http://www.psu.edu/bulletins/whitebook/$gradreqs.htm

Committee Responsibilities

The appointment of a doctoral committee constitutes a major shift in program orientation, requiring the candidate to consult regularly with at least three faculty advisors. The doctoral committee approves the graduate study plan, periodically reviews academic progress, advises the student on her/his area of specialization, guides the student's dissertation research, prepares and administers the comprehensive and final oral examination (the dissertation defense), and evaluates the student's doctoral dissertation. Continuing communication between the student and her/his doctoral committee members is strongly recommended so as to allow a mentoring process to develop and to preclude misunderstandings during the final stages of study.

Thesis Advisor

The candidate must designate a thesis advisor, normally the doctoral committee chair or co-chairs serve as thesis advisor(s). The thesis advisor directs the student's dissertation research. As such, she/he must specialize in the area of the chosen thesis.

Minor Field Member

If the student declares a minor, a faculty member representing that minor must be included on the doctoral committee. (additional specific requirements in the *Graduate Degree Programs Bulletin*: http://www.psu.edu/bulletins/whitebook/$gradreqs.htm)

Replacing committee members

A student may replace any or all members of the doctoral committee. To make committee changes, the student must complete a new *Doctoral Committee Appointment Signature Form*, have it signed by the new committee

member(s), and submit it to the Graduate Academic Programs office who will forward it to the Graduate School. Either the student or the incumbent (committee member) may suggest a replacement, however, all affected parties should meet and agree prior to formal action. The student must consult with her/his committee chair before replacing a committee member.

It is the responsibility of the Professor-in-Charge to periodically review the membership of doctoral committees to ensure that its members continue to qualify for service on the committee in their designated roles. For example, if budgetary appointments or employment at the University have changed since initial appointment to the committee, then changes to the committee membership may be necessary.

Comprehensive Examination

Upon the recommendation of the thesis advisor, the candidate should begin registering for thesis research when formal drafting of the dissertation proposal has begun. Ph.D. students are required to register continuously for Thesis Preparation (CE 601) from the time they begin formally writing their proposal until the Thesis is successfully defended. Thesis preparation (CE 601) carries no credits. No more than 12 research credits may receive a grade other than an "R".

Preparation of the Thesis Proposal

A formal, written proposal detailing the proposed doctoral research must be developed independently by the candidate. The research proposal serves as the first formal step in the thesis research. It documents a personalized plan for conducting the study, and, in addition, serves as a contract between the student and the doctoral committee regarding what is expected in the ensuing research. Led by the thesis advisor, the doctoral committee supervises the development of the student's proposal, conducts the proposal hearing and approves the proposal. Regular consultation with committee members is strongly encouraged. The research proposal must be submitted to the doctoral committee at least two weeks prior to the Oral Comprehensive Examination.

The typical research proposal includes:

1. a brief topic background, research motivation, and a concise statement of the problem;
2. a clear articulation of research objectives and a defined research scope;
3. a literature review to justify the research problem and establish the state-of-the-art;
4. a work plan, including scheme for data collection, data analysis, and hypothesis testing;
5. preliminary results;
6. anticipated results and expected presentation methods;
7. engineering significance;
8. Gantt chart showing the key activities and time schedule;
9. anticipated costs (i.e., estimates of labor-hours, supplies, equipment, computer charges, overhead, and other resources required to complete the proposed research); and,
10. references critical to the research.

The purpose of the oral comprehensive examination is to evaluate the candidate's competence and potential for conducting independent research. At least three but no more than five areas of competence consistent with the candidate's intended thesis research are established by the chair of the doctoral committee. The chair will advise the candidate of the selected areas of competence at least eight weeks prior to the comprehensive examination. The candidate is encouraged to discuss with individual doctoral committee members the material upon which the candidate will be examined. The Graduate Academic Programs Office must be notified a minimum of three weeks in advance of the Oral Comprehensive Examination so that Graduate School notification and approval can be completed.

The candidate will orally present and defend the research proposal as part of the oral comprehensive examination. The research proposal will be evaluated by the doctoral committee based on technical merit and other criteria deemed critical to the research by the doctoral committee. Approval of the proposal must have at least two-thirds favorable vote from the committee.

To be eligible for the comprehensive examination the candidate must meet the following criteria:

1. complete all core courses, and other requirements as determined by the doctoral committee;
2. achieve a minimum graduate coursework grade-point average of 3.00;
3. have no deferred or missing grades;
4. satisfy the English Competence requirement; and
5. be registered as a full-time or part-time student for the semester in which the examination is taken.

Students who have passed the oral comprehensive examination can maintain continuous registration by registering for credits in the usual manner or by enrolling for noncredit CE 601 (full-time thesis preparation) or 611 (part-time thesis preparation).

Continuous Registration and Satisfactory Scholarship

Degree candidates must maintain continuous registration (normally excepting summers) from the date of admission until all degree requirements have been satisfied. Candidates who do not maintain continuous registration may be dropped from the program and must apply for a resumption of study.

Research credits (CE 600 or CE 610) should reflect the time and effort spent in the laboratory, analyzing data, writing the thesis, or other activities specific to the thesis. Each candidate may receive up to 12 credits of quality grades ("A" through "F") for CE 600 or CE 610 activities. Advisers may also report an "R" (Research) grade for CE 600 and CE 610. All quality graded research credits beyond an accumulated 12 must be evaluated with an "R".

Satisfactory scholarship and acceptable progress toward the doctoral degree is required for continuance in the program. One or more failing grades or a cumulative grade-point average below 3.00 for any semester or session (or a combination thereof), may be considered as evidence of failure to maintain satisfactory scholarship.

CONDUCTING RESEARCH

Conducting research and writing a dissertation typically takes between two and three full years depending on the candidate's expertise and efforts, and the types of research methods employed. The candidate must accomplish the research according to the plan set forth in the proposal as presented to the doctoral committee. While conducting the research the candidate will be in regular communication with her/his thesis advisor and doctoral committee members. Major changes require approval of the doctoral committee.

WRITING AND DEFENDING THE DOCTORAL DISSERTATION

Writing Final Thesis Draft

The thesis advisor will ensure that the final draft includes all appropriate sections, is prepared according to an acceptable style, and is ready to be submitted to the doctoral committee. The candidate is responsible for the content and style. In addition, the candidate must follow the rules and deadlines of the Graduate School

concerning thesis preparation which are detailed in the *Thesis Guide: Requirements for the Preparation of Master's and Doctoral Theses* at: http://www.gradsch.psu.edu/current/thesis/guide.html.

Both the thesis advisor and the candidate are responsible for ensuring the completion of a draft of the thesis and for adequate consultation with members of the thesis committee well in advance of the oral examination. Major revisions to the thesis must be completed before the final oral examination. The thesis should be in its final draft, with appropriate notes, bibliography, tables, etc., at the time of the oral examination; both the content and style must be correct and polished by the time this final draft of the Thesis is in the hands of the committee.

Final Oral Examination Dissertation Defense

The final oral examination for CEE doctoral students is a public, oral examination administered and evaluated by the candidate's entire doctoral committee. The meeting is chaired by the student's doctoral committee chair. The final oral examination will consist of an oral presentation of the doctoral candidate's thesis and a public period of questions and candidate responses. Questions will normally relate directly to the thesis, but may cover the candidate's entire program of study because the major purpose of the examination is also to assess the student's general scholarly attainments. The portion of the examination in which the thesis is presented is open to the public.

Scheduling the Final Oral Examination

The length of the final oral examination is normally 2 to 3 hours and may be scheduled any time during the semester. However, the examination may not be scheduled until at least 90 days have elapsed after the comprehensive examination was passed. The examination is officially scheduled by the Office of Graduate Enrollment Services, on the recommendation of the Professor-in-Charge of the CEE program. A formal request for the final oral examination must be received by the Graduate Academic Programs Office at least three weeks prior to the scheduled examination. The doctoral candidate is responsible for scheduling the examination.

To schedule the final oral examination the candidate must:

1. be registered and in good standing for the semester in which the final oral examination is taken;
2. ensure that at least 90 days have elapsed between passing the comprehensive examination and the proposed final oral examination date;
3. satisfy all other requirements for the degree;
4. gain thesis advisor approval of the thesis draft;
5. negotiate, with all doctoral committee members, a final oral examination date;
6. notify the Graduate Academic Programs office at least three weeks prior to the proposed examination date; and
7. Additional Graduate School requirements for the conduct of the final oral examination are presented at: http://www.gradsch.psu.edu/current/thesis/guide.html.

Final Oral Examination Results

Immediately following the oral examination the doctoral committee will meet to formally evaluate the candidate's work and cast votes. A favorable vote of at least two-thirds of the members of the committee is required to pass the final oral examination. If the student fails, it is the responsibility of the doctoral committee to determine whether a second final oral examination will be granted. A candidate may not be allowed more than two attempts at the final oral examination. The Graduate Academic Programs office will communicate the results to the Office of Graduate Enrollment Services.

FINAL DISSERTATION DOCUMENT

After passing the final oral examination, doctoral candidates must make the necessary corrections or revisions suggested by the committee members, and prepare the thesis in final form. Candidates must allow sufficient time to make revisions in order to meet the deadlines of the CEE program and the Graduate School. (See Graduate School Calendar at: http://www.gradsch.psu.edu/calendar/). Candidates must present their final thesis to the Graduate Academic Programs office for signature no later than three weeks before the deadline set by the Graduate School.

Original signatures of all doctoral committee members must appear on the appropriate page in proper form when the thesis is presented to the Graduate Academic Programs office. Once signed, the student delivers the dissertation to the Thesis Office. In addition:

1. It is customary for the student to present a library-bound copy to the thesis advisor and committee members.
2. Follow the instructions from the Graduate School Thesis Office for the submission of one thesis copy to the Pattee Library.

GRADUATION

To graduate, students must activate your intent to graduate on eLion and payment of the thesis fee are necessary during the semester in which one wishes to graduate. Check the specific deadlines and fee requirements listed in the Graduate Bulletin (http://bulletins.psu.edu/bulletins/whitebook/).

PART VII: APPENDICES AND ATTACHMENTS

Appendix A	Graduate Assistantships and Fellowships
Appendix B	Reinstatement and Extension of Time-To-Degree Policies
Appendix C	Resume Study/Change of Graduate Degree or Major Policy
Appendix D	Master of Science Timeline
Appendix E	Doctor of Philosophy Timeline
Appendix F	Guiding Principles for Good Practice in Graduate Education
Appendix G	Student Chapters and Societies

Graduate School Forms: http://www.gradsch.psu.edu/facstaff/forms/ges.html

APPENDIX: A
Graduate Assistantships and Fellowships

This appendix describes graduate research assistantships and fellowships for which CEE students are eligible. Other forms of financial aid are described in the Student Aid section of the Graduate Degree Programs Bulletin: http://www.psu.edu/bulletins/whitebook/$aid.htm. All financial aid is awarded on a competitive basis and is limited. Students are advised to consider alternative sources, in addition to graduate research assistantships and fellowships, to fund their graduate education. To be considered for a graduate research assistantship or fellowship for the succeeding academic year students must complete their application package by February 1. Students should apply for all sources of financial aid simultaneously rather than sequentially in order of preference. All applicants are considered for funding at the time the application is reviewed for admission.

Penn State, along with some 370 graduate institutions, subscribes to the "April 15th Resolution" of the Council of Graduate Schools. This states that acceptance of an offer of financial aid prior to April 15 is not binding up to April 15. After that, the student may not accept an offer from another institution without first obtaining a formal release from the previous commitment. Selection of recipients of all University awards is made without regard to the sex, race, religious belief, ethnic origin, disability, or age of the applicant, as established by law.

Graduate Research Assistantships

Each academic year, faculty in the Department of CEE offer a limited number of graduate research assistantships (GRAs). GRAs are typically half-time assistantships. The research assistant normally schedules 9 to 12 credits of course work per semester (4 to 6 in summer session), receives a stipend plus a remission of tuition, and performs tasks (primarily research with limited administrative duties) that occupy approximately twenty hours per week. Although classes meet for fifteen weeks per semester, GRA are appointments for eighteen weeks of activities per semester. Accordingly, the duties in an academic year appointment (thirty-six weeks) begin in mid-August and continue until mid-May.

GRA reappointment is based on availability of positions and the quality of the student's academic and professional performance. Unsatisfactory academic performance in any semester is sufficient cause for termination of the appointment at the end of that period. Unsatisfactory performance of assistantship duties is also sufficient cause for termination at any time.

Graduate Teaching Assistantships

Each academic year the Department of CEE offers a limited number of graduate teaching assistantships (GTAs). GTAs are typically half-time assistantships. The teaching assistant normally schedules 9 to 12 credits of course work per semester (4 to 6 in summer session), receives a stipend plus a remission of tuition, and performs tasks (primarily teaching with limited administrative duties) that occupy approximately twenty hours per week. Although classes meet for fifteen weeks per semester, GTAs are appointments for eighteen weeks of activities per semester. Accordingly, the duties in an academic year appointment (thirty-six weeks) begin in mid-August and continue until mid-May.

Legislation passed by the University Faculty Senate requires that all newly appointed teaching assistants participate in a TA training program (unless they can provide evidence of successful prior teaching experience) and that all new international TAs take and pass American English Oral Communicative Proficiency Test (AEOCPT). Details for taking the AEOCPT are available at the Department of Linguistic and Applied Language Studies website at: http://lals.la.psu.edu/ita_aeocpt.php.

Fellowships

The College of Engineering as well as the Department of CEE awards various fellowships. In addition, there are a number of university-wide fellowships that are awarded each year. Fellows are required to carry at least 9 credits of course work each semester or the equivalent in research, receive stipends that vary with the awards, and usually receive remission of tuition. They may not accept employment during the period of their appointments (except with special permission for training purposes) nor are they required to render any service to the University. Scholarly excellence is always a major consideration and usually the most important criterion in selecting fellowship recipients. Other considerations, in addition to scholarly excellence, may be taken into account.

Program Fellowships and Scholarships

CMT Laboratories Graduate Scholarship
Consideration of this scholarship shall be given to all students who plan to pursue studies in the concrete materials or related area(s).

J. Roger Glunt Fellowship
Consideration for this fellowship shall be given to all full-time graduate students who manifest promise of academic achievement, demonstrate qualities of leadership, perseverance, and dependability, and who have declared an interest in housing.

George W. Johnstone Graduate Fellowship
Consideration for this fellowship shall be given to all full-time graduate students who are United State citizens, who exhibit academic excellence, and who have been admitted to the department. Preference shall be given to students who are candidates for a graduate degree in the Environmental Engineering area.

Cecil M. Pepperman Memorial Graduate Fellowship
Consideration of this fellowship shall be given to all students who plan to pursue studies in one of the following fields, listed in order of priority: water treatment and management, water pollution control, environmental engineering, or related fields.

Leo P. Russell
Consideration for this fellowship shall be given to full-time graduate students who plan to pursue studies in Materials and Pavement Design, Transportation Engineering or related fields.

University-Wide Fellowships

University Graduate Fellowships: University Graduate Fellowships are awarded by the Graduate School to approximately eighty outstanding incoming students. Fellows receive a stipend and remission of tuition. Fellows are required to enroll as full-time students.

Bunton-Waller Graduate Awards:
These are assistantships and fellowship supplements granted to incoming students as a part of the University's comprehensive plan to increase diversity. The graduate admission application serves as the Bunton-Waller Graduate Awards application. Applications are submitted through the CEE program as part of the normal application process. The program must guarantee funding for the second year before an award for the first year is made. For more information, contact the Graduate School Fellowship and Award Office, 313 Kern Building; www.gradsch.psu.edu/prospective/funding/programs/minority.html.

APPENDIX: B
Reinstatement and Extension of Time-To-Degree Policies

Reinstatement

Full-time students are expected to take the candidacy examination during their second or third semester in the program. Full-time students who have not taken the candidacy examination at the conclusion of their third semester will be terminated from the program. Students who are terminated for not taking the candidacy examination within the allotted time period will be treated as new applicants, should they desire reinstatement.

Extension -- Completed Candidacy Examination

The *Graduate Bulletin* reads: "A doctoral student is required to complete the program, including acceptance of the doctoral thesis, within eight years from the date of successful completion of the candidacy examination. Individual programs may set shorter time limits." Accordingly, the Department of CEE requires the following procedure for doctoral enrollees who wish to be reinstated, who have not completed their degree within the eight year limit:

1) The student completes and submits a Resume Study form, and includes a current Statement of Objectives, Transcript, and Three Reference Letters.
2) Faculty members within the applicant's area of interest review the student's application.
3) Based on information gathered the faculty makes one of the following recommendations:

Reinstate Unconditionally	Reinstate Conditionally
The student is allowed to resume her/his study without having to take a second candidacy examination or to complete additional course work	The student is allowed to resume her/his study on one or more of the following conditions: • The Student is required to pass a second candidacy examination, • The student is required to take additional course work, specified by the faculty advisor, and to maintain a 3.0 GPA.

Extension -- Completed Comprehensive Examination

The *Graduate Bulletin* reads: "When a period of more than six years has elapsed between the passing of the comprehensive examination and the completion of the program, the student is required to pass a second comprehensive examination before the final oral examination (dissertation defense) will be scheduled." Accordingly, the Department of CEE requires the following procedures for doctoral candidates who wish to be reinstated, who have not completed their dissertation defense within the six year limit:

1) The student completes and submits a Resume Study form, and includes a current Statement of Objectives, Transcript, and Three Reference Letters.
2) Faculty members within the applicant's area of interest review the student's application.
3) Based on information gathered the faculty makes one of the following recommendations:

Reinstate Unconditionally	Reinstate Conditionally

The student is allowed to resume her/his study without having to take a second comprehensive examination or to complete additional course work.	The student is allowed to resume her/his study on one or more of the following conditions: • The student is required to pass a second comprehensive examination, • The student is required to take additional course work, specified by the faculty advisor, and to maintain a 3.0 GPA.

APPENDIX: C
Resume Study/Change of Graduate Degree or Major Policy

Resume Study

CEE students who wish to change their degree from MS to PhD within the department should submit a *Resume Study/Change of Graduate Degree or Major* form and a new Statement of Purpose to the program staff assistant.

Change of Degree or Major: Doctoral Degree Applicants

Students who are currently enrolled in a doctoral degree program at Penn State may apply to the Ph.D. program in CEE by submitting an application to:

Civil & Environmental Engineering
216 Sackett Building
University Park, PA 16802

The application packet includes the following:

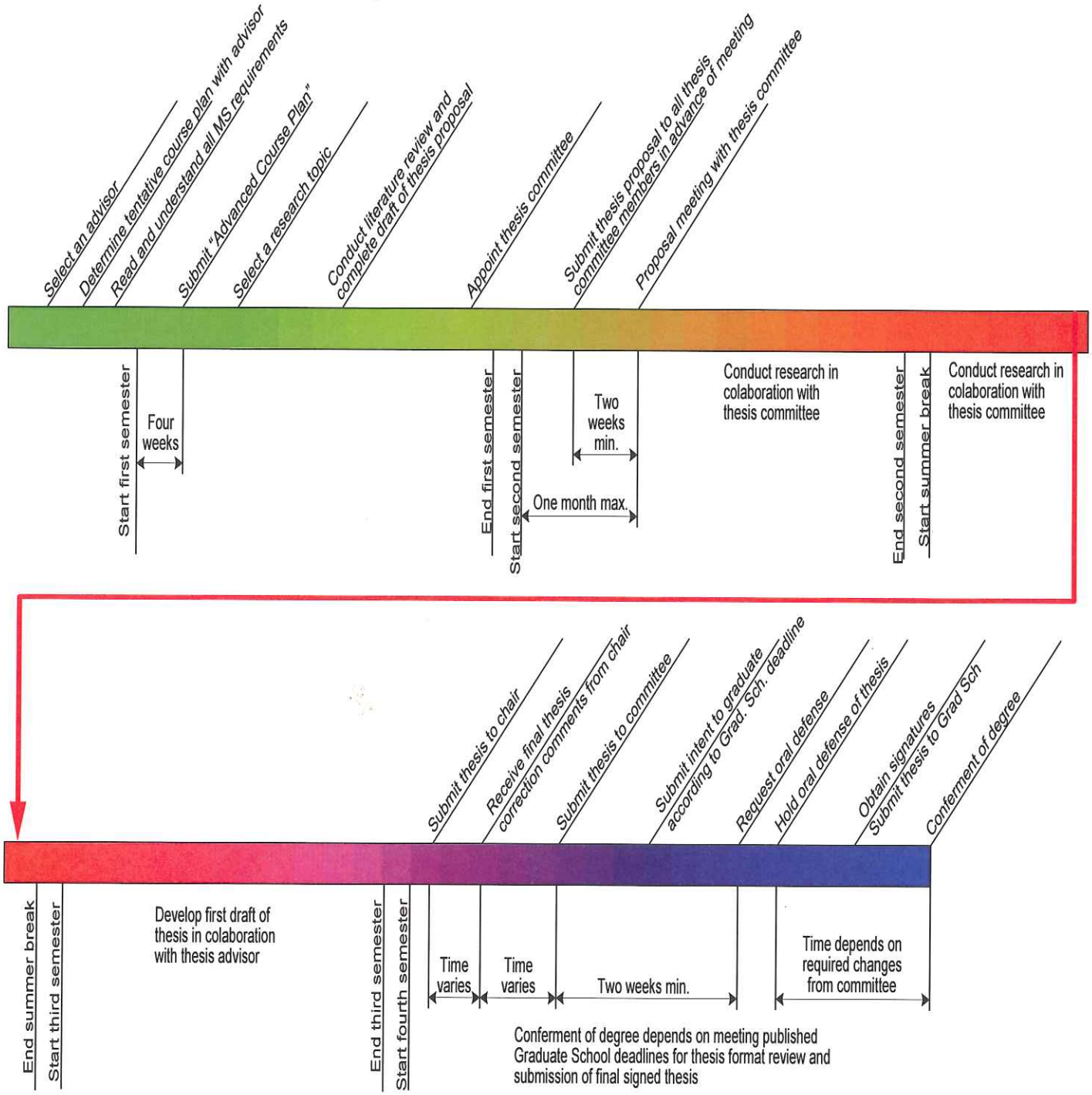
1) A completed *Resume Study/Change of Graduate Degree or Major* form, obtainable at: http://forms.gradsch.psu.edu/ges/reschg2.pdf or from the CEE staff assistant.
2) A statement of purpose describing the applicant's short and long range career objectives. This statement includes an explanation of how the proposed study of CEE relates to the stated career objectives.
3) A current vitae or resume
4) A recent transcript
5) Three letters of recommendation from people who are best qualified to evaluate the applicant's ability to succeed in graduate study. These letters may be from an academic advisor, instructors who are familiar with the applicant's academic record, a research project supervisor, an employment supervisor, or others who are able to provide a substantive evaluation of the applicant's work. Letters of recommendation must address the applicant's academic ability, motivation, and likelihood of success in completing the program.

Change of Degree or Major: Master's Degree Applicants

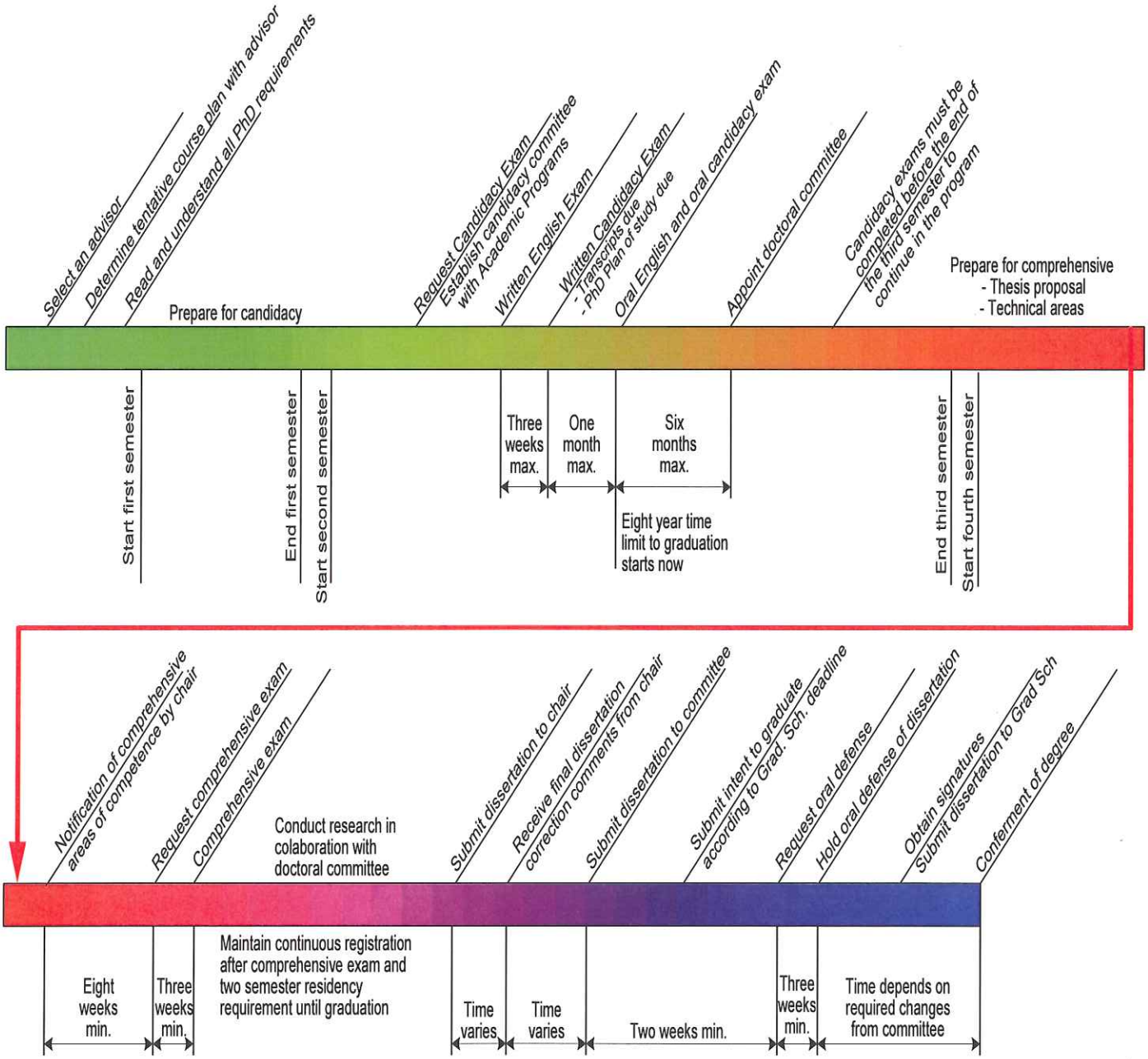
Students who are currently enrolled in a master's degree (M.Eng., M.S.) at Penn State may apply to the Ph.D. in CEE by submitting an application to: Civil & Environmental Engineering
216 Sackett Building
University Park, PA 16802

The application packet should include the same information listed above.

APPENDIX: D
Master of Science Timeline



APPENDIX: E
Doctor of Philosophy Timeline



Guiding Principles for Good Practice in Graduate Education

Working relationships between faculty, staff, and students are an important component of graduate education at Penn State. The quality of these relationships can make or break the graduate school experience. The development of a positive learning environment depends on a shared vision of educational vaiues, objectives and expectations. It is the joint responsibility of faculty, staff, and students to work together to nurture this vision, and to encourage freedom of inquiry, demonstrate personal and professional integrity, and insure a climate of mutual respect.

The following six principles are essential elements in a productive environment for graduate education at Penn State:

Understanding the work environment.

Faculty, staff, and students must each take the initiative to learn the policies, rules, regulations, and practices that affect them, their work, and the units in which they work. Graduate program handbooks, pertinent University publications, funding agency references, and other resources can typically be obtained from graduate program officers, the Internet, registered student organizations, department faculty, other students, faculty advisors, and thesis committee chairs.

Academic honesty, professional integrity, and confidentiality.

These qualities are the responsibility of all faculty, staff; and students. Each member of the graduate community must endeavor to adhere to the highest level of these ideals in all their personal and professional activities.

A clear course of study.

The student and his/her faculty advisor should develop and agree upon a clear plan of academic study and the responsibilities associated with it. Careful planning and discussion throughout a graduate program are the best ways to avoid later misunderstandings and problems.

An atmosphere of openness.

Students and faculty must work to establish and maintain an environment that is open, sensitive, and encourages free discussion between members of the graduate community. Clear, two-way communication is a critical ingredient in a successful graduate experience.

Acknowledgement of intellectual rights and property.

Students and faculty should discuss issues associated with academic freedom, intellectual property, authorship, and publication as part of the student's academic plan. Resolution of these issues early in the graduate program is often the best way to avoid later disputes.

Opportunities for evaluation.

Evaluation, reflection, and feedback are integral parts of the academic process. These items should be a regular part of every graduate program. Early, frequent, and constructive feedback help to prevent small differences from becoming serious problems.

While these six guiding principles are not exhaustive, they do reflect a spirit that can make the graduate education process at Penn State more rewarding and productive for everyone.

APPENDIX: G
Student Chapters and Societies

AMERICAN CONCRETE INSTITUTE

The ACI (American Concrete Institute) student club is open to any student interested in concrete structures or materials. Each semester, student teams travel to the national convention for competitions in areas such as strongest cube, FRP beam, concrete bowling ball, and concrete egg protection device. Activities also include guest speakers from the concrete profession and certification opportunities. Advisors are Dr. Andrew Scanlon and Dr. Farshad Rajabipour.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE is the professional civil engineering society, with a student chapter open to freshmen and sophomores interested in the organization and all students enrolled in civil engineering. This organization was established to expand the college experience for students in civil engineering and aid in establishing the professional contacts that are so valuable to the practicing engineer. Student chapter members hold offices, secure speakers for chapter meetings, visit engineering works, attend professional meetings, present papers, ad keep abreast of professional activities through ASCE publications. These activities stimulate early professional consciousness and prepare students for entry into the profession and into the American Society of Civil Engineers. Dr. Norman Folmar is the chapter advisor.

NATIONAL ASSOCIATION OF HOME BUILDERS (NAHB)

The National Association of Home Builders (NAHB) Student Chapter is a focus for students interested in housing, light commercial construction, and development. It provides students with the opportunity to learn more about the housing industry. Students who are in the following majors are eligible for membership in the NAHB Student Chapter: Civil and Environmental Engineering, Architectural Engineering, Architecture, Landscape Architecture and Real Estate. There are a number of benefits, professional, academic and social, to joining the student chapter not the least of which are the opportunity to apply for:

1. Travel Grants
   By joining the NAHB Student Chapter you have an opportunity to win an expenses-paid trip to the NAHB National Convention in Atlanta. The writers of the best essays will be awarded a travel grant to attend this Convention. On average, 3 to 4 students are selected (from the entrants) for this award. The NAHB Student Chapter member packet contains specific details including eligibility, requirements, procedures and deadlines.
2. Scholarships
   If you are truly interested in housing and your "career objective" lie with the residential and light construction industry (i.e., family ties to the industry, desire to work for a residential development or engineering/surveying firm associated with the industry, desire to eventually manage one's own firm, etc.) then you are a good candidate to receive a scholarship from the NAHB Student Chapter. Refer to the NAHB Student Chapter member packet for specific details including eligibility, requirements, procedures and deadline.You have to be a member to receive ither a travel award or scholarship. The faculty advisor to the student chapter is Dr. Ali Memari, who is also Hankin Chair.