

# CIVIL ENGINEERING (CAPITAL)

<b>Graduate Program Head</b>	Vahid Motevalli
<b>Program Code</b>	CENG
<b>Campus(es)</b>	Harrisburg (M.S.)
<b>Degrees Conferred</b>	Master of Science (M.S.) Integrated B.S. in Civil Engineering and M.S. in Civil Engineering
<b>The Graduate Faculty</b>	View ( <a href="https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=CENG">https://secure.gradsch.psu.edu/gpms/?searchType=fac&amp;prog=CENG</a> )

Both the United States' and Pennsylvania's infrastructure have been given poor grades in the latest infrastructure report cards by the American Society of Civil Engineers. The next generation of civil engineers will be tasked with repairing and modernizing existing horizontal and vertical infrastructure to ensure that it is safe, sustainable, and resilient in the face of current and future hazards. We also will need to build out new infrastructure to accommodate the needs of people and businesses, all while keeping the protection of public health and safety at the forefront of our designs. This will require not just the strong understanding of structural, environmental, transportation, geotechnical, construction, and water resources fundamentals, but also the ability to apply modern design principles and tools to solve these wicked challenges of the future.

The Master's of Science in Civil Engineering at Penn State Harrisburg is designed to ensure that you are prepared to meet these challenges in your specialty area of civil engineering: structural, transportation, and/or water resources. The program can accommodate the needs of working professionals, as well as full-time students, with most classes offered in the evening. Some classes are offered in a hybrid or web format so that students do not have to commute to campus every week. Strong connections with local industry and with government agencies allows the faculty to bring experts into classes to create connections and allow students to understand how their master's degree is immediately useful in the profession. Updated laboratories and computing facilities support classroom experiences and student research.

For students wishing to focus in environmental and water resources engineering, they can select this option. The option ensures that Environmental and Water Resources Engineering will be listed on their transcript to highlight this focus.

## Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<https://gradschool.psu.edu/graduate-admissions/how-to-apply/>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

Admission into the Master of Science (M.S.) Civil Engineering program will be granted only to candidates who demonstrate high potential for success in graduate studies. Applicants should have undergraduate degrees in engineering or technology-related fields from an accredited university and must meet the admission requirements as set by Penn State's Graduate School. For admission, an undergraduate cumulative grade-point average of 3.0 or better on a 4.0 scale. Scores from the GRE are required for those who indicate an interest in a school/college-funded assistantship.

Exceptions to the minimum 3.00 grade-point average may be made for students with special backgrounds, abilities, and interests. Students with a baccalaureate degree in non-civil engineering and engineering technology could be admitted on a provisional basis (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/gcac-303-provisional-admission/>) pending successful completion of prerequisite courses within 1-2 semesters of admission.

Applicants should submit the following:

- a completed Graduate School online application with the application fee;
- official transcripts from all post-secondary institutions attended (<http://www.gradschool.psu.edu/prospective-students/how-to-apply/new-applicants/requirements-for-graduate-admission/>);
- three (3) letters of professional recommendations from individuals who can evaluate the applicant's potential;
- a personal statement of professional interest, goals, and experience;
- test scores from the Graduate Record Examination (GRE); and
- a statement of interest in a graduate assistantship, if desired (full-time study required).

The language of instruction at Penn State is English. English proficiency test scores (TOEFL/IELTS) may be required for international applicants. See GCAC-305 Admission Requirements for International Students (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/gcac-305-admission-requirements-international-students/>) for more information.

## Prerequisite Courses

Students may be admitted to the program from various engineering/engineering technology disciplines. Students applying for admission are expected to have B.S. degree in engineering/engineering technology and completed the following core courses:

- Physics I and II (one year of college physics);
- Calculus I and II (differential and integral calculus);
- Differential equations;
- Chemistry (one semester);
- Statics;
- Dynamics; and
- Strength of materials.

## Degree Requirements

### Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (<https://gradschool.psu.edu/graduate-education-policies/>)

All graduate students in Civil Engineering are required to adhere to the requirements of the Graduate School, as found in the Graduate Degree Programs Bulletin. The requirements of the Graduate School, however, are minimum requirements and the policies, procedures, and regulations listed below are additional and more specific for graduate students pursuing the M.S. in Civil Engineering degree. Advisers will call pertinent regulations to the attention of their advisees, but it should be understood that it is the student's personal responsibility to see that all requirements are satisfied.

The M.S. CE program at PSH is structured to take full advantage of the specialty areas of expertise of the CE Graduate Faculty. The M.S. degree with the thesis track requires 31 credits at the 400, 500, 600, or 800 level, including 24 course credits with at least 12 credits at the 500 level, one colloquium credit (CE 590), and six thesis credits (CE 600 or CE 610). The thesis must be accepted by the advisers and/or committee members, the head of the graduate program, and the Graduate School, and the student must pass a thesis defense.

The M.S. degree with the non-thesis track also requires 31 credits at the 400, 500, or 800 level, including 27 course credits with at least 15 credits at the 500 level, one colloquium credit (CE 590), and three research/paper credits (ENGR 594).

All M.S. CE students are required to take an advanced math or statistics course (EMCH 524A or STAT 500), and EMCH 500 or CE 437, and colloquium (CE 590). Students will take 12 (thesis) or 15 (non-thesis) credits of civil engineering courses, selected from offerings in structural, construction, transportation, water resources, and environmental with 9 (thesis) or 12 (non-thesis) credits at the 500-level.

*Elective Courses.* Students will take six (6) additional elective credits at either the 400- or 500-level. These electives may be taken from civil engineering courses or courses offered by other departments that meet the objective of the M.S. CE degree. The student can work with their adviser to select courses that either focus on a specific area of civil engineering or that provide a robust in-depth background of multiple areas of civil engineering. A maximum of four 400-level courses (12 credits) may be taken for the M.S. CE degree.

*Culminating Experience.* For a thesis, original research, requiring at least two semesters of work (up to 6 credits), is expected. The work should be an in-depth investigation intended to extend the state of knowledge in a specialty area. The thesis must be accepted by the advisers and/or committee members, the head of the graduate program, and the Graduate School, and the student must pass a thesis defense. For the non-thesis track, a scholarly paper is required while the student is enrolled in ENGR 594. The paper should be an inquiry in a specialty area. The paper must be accepted by the advisers and/or committee members, the head of the graduate program, and the student must pass the paper defense.

*Additional Requirements.* A maximum of three credits of independent study (CE 596) may be applied towards the M.S. CE degree program, but the undergraduate individual study course (CE 496) will not count towards program credit requirements.

All students are expected to complete one credit of colloquium (CE 590) during the first two semesters of study. Degree requirements must be completed during a six-year period.

Penn State Harrisburg's M.S. CE program is distinct and independent of the M.S. CE program offered at the University Park campus.

### Environmental Option

Code	Title	Credits
<b>Core Courses</b>		
EMCH 524A or STAT 500	Mathematical Methods in Engineering Applied Statistics	3
EMCH 500 or CE 437	Solid Mechanics Engineering Materials for Sustainability	3
<b>Required Environmental Option Courses</b>		
ENVE 591	Research Methods in Environmental Engineering	1

ENVE 569	Environmental Risk Assessment	3
Select 3 credits of environmental chemistry or biology from the following list:		3
CE 570	Environmental Aquatic Chemistry	
ENVE 540	Biodegradation and Bioremediation	
ENVE 550	Chemical Fate and Transport	
Select 3 credits of design engineering in environmental and water resources:		3
ENVE 411	Water Supply and Pollution Control	
ENVE 415	Hydrology	
ENVE 417	Hydraulic Design	
CE 462	Open Channel Hydraulics	
CE 555	Groundwater Hydrology: Analysis and Modeling	
CE 571	Physical-Chemical Treatment Processes	
CE 572	Biological Treatment Processes	
<b>Total Credits</b>		<b>16</b>

## Integrated Undergrad-Grad Programs

### Integrated B.S. in Civil Engineering and M.S. in Civil Engineering

This Integrated Undergraduate/Graduate (IUG) degree program combines the B.S. in Civil Engineering with the M.S. in Civil Engineering offered at the following campuses:

#### Undergraduate Degree

- Harrisburg
- University Park

#### Graduate Degree

- Harrisburg

The graduate portion of this IUG is currently offered as face-to-face residential instruction. While the undergraduate curriculum for this IUG may be completed at multiple campuses, the ease and feasibility of completing the integrated program may be heavily dependent upon the location of the graduate instruction. Please discuss the feasibility of completing the IUG with a representative for the graduate program.

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs/>).

The Civil Engineering program offers a limited number of academically superior Bachelor of Science candidates the opportunity to enroll in an integrated, continuous program of study leading to both the Bachelor of Science and the Master of Science in Civil Engineering. The ability to coordinate as well as concurrently pursue the two degree programs enables students to earn the two degrees in five years.

Students in the IUG program must satisfy the degree requirements for both Bachelor of Science and Master of Science degrees. However, the total course load is reduced due to the maximum of 12 credits that can count towards both degrees. A minimum of 6 credits proposed to count for both degrees must be at the 500 level. Thesis, master's paper, and undergraduate capstone credits may not be double counted. The fourth year of the IUG program differs from the fourth year of the Bachelor of

Science program due to the courses that count toward the Master of Science Degree requirements.

Student performance will be monitored on an on-going basis. In addition, a formal evaluation of a student's academic performance will be conducted at the end of the first semester of the senior year for a typical program student. Students who have not maintained a 3.0 retention GPA in their Math and Civil (CE/ENVE) Engineering courses will be put on probationary status with respect to the IUG program. Their ability to continue in the IUG program will be based on academic performance in the last semester of their fourth year. As part of the review in the fourth year, students will be advised about the thesis or master's paper requirement in the graduate program.

If for any reason a student admitted to the IUG program is unable to complete the requirements for the Master of Science degree, the student will be permitted to receive the Bachelor of Science degree assuming all the undergraduate degree requirements have been satisfactorily completed. If students successfully complete courses listed in the recommended schedule, they will satisfy the requirements for the Bachelor of Science degree by the end of their fourth year.

### Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<https://gradschool.psu.edu/graduate-admissions/how-to-apply/>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (<https://gradschool.psu.edu/graduate-education-policies/>).

Students must apply to the program via the Graduate School application for admission (<http://www.gradschool.psu.edu/prospective-students/how-to-apply/>), and must meet all the admission requirements of the Graduate School and the Civil Engineering graduate program for the Master of Science degree, listed in the Admission Requirements section. Students must submit:

- an official transcript
- three letters of professional recommendation from individuals who can evaluate the applicant's potential
- a personal statement of technical interest and goals

A faculty adviser will help undergraduate candidates determine a sequence of courses that will prepare them for acceptance into the Integrated Undergraduate-Graduate (IUG) degree program. In order to apply for this IUG program, students must have completed entrance to the undergraduate major and a minimum of 83.5 credits; therefore, a typical student would apply after completing the fifth semester and before the end of the sixth semester. Students must be admitted no later than the end of the second week of the semester preceding the semester of expected conferral of the undergraduate degree. Transfer students must have completed at least 15 credits at Penn State to enroll in an IUG. For consideration for acceptance into the program, students must have an admissions cumulative grade point average (GPA) of 3.3 or better and an admissions collective GPA of 3.3 or better in the following courses:

Code	Title	Credits
CE 310	Surveying	
CE 335	Engineering Mechanics of Soils	
CE 336	Materials Science for Civil Engineers	
CE 340	Structural Analysis	
CE 360	Fluid Mechanics	

### CE 370 Introduction to Environmental Engineering

And all the designated MATH and EMCH courses

Applications will be evaluated based on the students' overall academic performance, in addition to the above requirements. In all cases, admission to the program will be at the discretion of the Graduate Admissions Committee of the Civil Engineering program.

### Degree Requirements

Students must fulfill all degree requirements for each degree to be awarded that degree, subject to the double-counting of credits as outlined below. Degree requirements for the Bachelor of Science in Civil Engineering are listed in the Undergraduate Bulletin (<http://bulletins.psu.edu/undergraduate/>). Degree requirements for the Master of Science in Civil Engineering degree are listed on the Degree Requirements tab. Students must sequence their courses so all undergraduate degree requirements are fulfilled before taking courses to count solely towards the graduate degree. Students are expected to complete the undergraduate degree requirements within the typical time to degree for the undergraduate major. In the semester in which the undergraduate degree requirements will be completed, IUG students must apply to graduate, and the undergraduate degree should be conferred at the next appropriate Commencement.

Up to 12 credits may be double-counted towards the degree requirements for both the graduate and undergraduate degrees; a minimum of 50% of the double-counted courses must be at the 500 or 800 level. Independent study courses and credits associated with the culminating experience for the graduate degree cannot be double-counted. The double-counted classes (required and elective) are listed below:

Code	Title	Credits
<b>Courses Eligible to Double Count for Both Degrees</b>		
<i>Math Core Requirements</i>		
EMCH 524A	Mathematical Methods in Engineering	3
or STAT 500	Applied Statistics	
<i>Materials</i>		
EMCH 500	Solid Mechanics	3
or CE 437	Engineering Materials for Sustainability	
<i>Electives</i>		
CE 422	Transportation Planning	3
CE 423	Traffic Operations	3
CE 424	Project Info. Modeling	3
CE 434	Geotechnical Engineering Design	3
CE 435	Foundation Engineering	3
CE 436	Construction Engineering Materials	3
CE 441	Structural Design of Foundations	3
CE 445	Advanced Structural Analysis	3
CE 447	Structural Analysis by Matrix Methods	3
CE 449	Advanced Structural Design	3
CE 456	Planning and Scheduling	3
CE 458	Construction Management II	3
CE 462	Open Channel Hydraulics	3
ENVE 411	Water Supply and Pollution Control	3
ENVE 415	Hydrology	3
ENVE 417	Hydraulic Design	3
ENVE 430	Sustainable Engineering	3
CE 511	Engineering Soil Characteristics	3

CE 512	Soil Mechanics II	2-5
CE 521	Transportation Networks and Systems Analysis	3
CE 522	Traffic Flow Theory and Simulation	3
CE 523	Analysis of Transportation Demand	3
CE 525	Transportation Operations	3
CE 526	Highway and Street Design	3
CE 528	Transportation Safety Analysis	3
CE 529		
CE 539	Approximate Methods of Structural Analysis	3
CE 540	Statically Indeterminate Structures	3
CE 541	Structural Analysis	3
CE 543	Prestressed Concrete Behavior and Design	3
CE 544	Design of Reinforced Concrete Structures	3
CE 545	Metal Structure Behavior and Design	3
CE 548	Structural Design for Dynamic Loads	3
CE 549	Bridge Engineering I	3
CE 550	Engineering Construction Management	3
CE 555	Groundwater Hydrology: Analysis and Modeling	3
CE 566	Uncertainty and Reliability in Civil Engineering	3
CE 570	Environmental Aquatic Chemistry	3
CE 571	Physical-Chemical Treatment Processes	3
CE 572	Biological Treatment Processes	3
CE 581	Pavement Management and Rehabilitation	3
CE 582	Pavement Design and Analysis	3
CE 583	Bituminous Materials and Mixtures	3
CE 584	Concrete Materials and Properties	3
ENVE 540	Biodegradation and Bioremediation	3
ENVE 550	Chemical Fate and Transport	3
ENVE 569	Environmental Risk Assessment	3

The MSCE faculty has established a six-year time limit for completion of the M.S. degree. Any extension beyond six years requires the approval of the program's Graduate Faculty.

Students must maintain a minimum retention grade point average (GPA) of 3.00 or better on a 4.00 scale in 500- and 400-level courses listed on their Plan of Study.

## Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>) and GCAC-700 Professional Degree Policies (<https://gradschool.psu.edu/graduate-education-policies/>), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/>)
- GCAC-641 Minor - Research Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/>)
- GCAC-709 Minor - Professional Doctorate (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/>)

- GCAC-741 Minor - Professional Master's (<https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/>)

## Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (<https://gradschool.psu.edu/graduate-funding/>) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (<https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/>) set by The Graduate School.

Students are encouraged to talk to the faculty in the program to discuss opportunities to assist in research whether part-time or full-time.

## Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Civil Engineering (CE) Course List (<https://bulletins.psu.edu/university-course-descriptions/graduate/ce/>)

## Learning Outcomes

1. **KNOW:** Graduates will be able to demonstrate broad mastery of core principles in resilient and sustainable civil infrastructure engineering as well as in-depth mastery in one concentration area (structural, transportation, environmental/water resources).
2. **THINK:** Graduates will be able to critically and creatively conceptualize, evaluate and formulate civil infrastructure engineering problems, as well as perform the analyses required for problem definition. All MSCE courses are taught with a significant design component that builds on the theory that students learn throughout their education. The graduate courses provide the class time for in-depth study of a specific area of civil engineering that does not occur in the undergraduate degree where the topic may be part of a larger course.
3. **APPLY/CREATE:** Graduates will be able to apply advanced knowledge, techniques, skills, and state of the practice tools to solve civil infrastructure engineering problems. In class, MSCE students are exposed to relevant challenges in the class topic area, such as structural failures, life span/life cycle analysis, flooding, and water pollution, and then, they apply the theory learned in class to solve these problems and to prevent further disasters, especially in a changing climate and where there is pressure to develop in areas that were previously considered unsuitable for urban development.
4. **COMMUNICATE:** Graduates will be able to effectively communicate, both orally and in writing, project outcomes, such as ideas, requirements, designs, analyses, findings, and justification for decisions. MSCE students demonstrate their communication skills by illustrating problem solutions, writing project reports, and presenting observations, conclusions, and recommendations for class and program requirements.
5. **PROFESSIONAL PRACTICE:** Engineering ethics and professionalism (linked to Goal #5): Graduates will be able to demonstrate an

understanding of professional and ethical responsibility and conduct themselves accordingly. MSCE students participate in SARI training and in-class ethics and professional licensing discussions. Students demonstrate their professionalism while interacting with instructors, project sponsors, and classmates.

## Contact

<b>Campus</b>	Harrisburg
<b>Graduate Program Head</b>	Vahid Motevalli
<b>Director of Graduate Studies (DGS) or Professor-in-Charge (PIC)</b>	Grady F Mathews
<b>Program Contact</b>	Heather Lookenbill Penn State Harrisburg 777 W. Harrisburg Pike, W236 Olmsted Middletown PA 17057 hpl5273@psu.edu (717) 948-4350
<b>Program Website</b>	View ( <a href="https://harrisburg.psu.edu/science-engineering-technology/civil-structural-construction/masters-science-civil-engineering/">https://harrisburg.psu.edu/science-engineering-technology/civil-structural-construction/masters-science-civil-engineering/</a> )