

CIVIL AND ENVIRONMENTAL ENGINEERING

THE GEORGE R. BROWN SCHOOL OF ENGINEERING

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Nadathur Varadarajan

Steve Wilkerson

DEGREES OFFERED: BS, BA, MCEE, MS, PHD

Civil and environmental engineering (CEE) is a broad and diverse field of study that offers students an education with several degree options. The most flexible degree options are at the bachelor's level, where students can major in civil engineering (BS or BA) or environmental engineering sciences (BA) or complete a double major with any other Rice University major. One nonthesis graduate degree (MCEE) is available to students who desire additional education and specialization in civil engineering, environmental engineering, or environmental sciences. Joint MBA/Master of Engineering degrees also are available in conjunction with the Jesse H. Jones Graduate School of Management.

Students admitted for graduate study leading to MS or PhD degrees must complete a rigorous course of study that combines advanced course work with scholarly research culminating in the public defense of a written thesis. Graduate research is carried out in a range of areas reflecting the interests of the department's faculty. Examples include environmental engineering, geotechnical engineering, structural engineering and mechanics, hydrology, water resources and water quality management, air pollution and its control, and hazardous waste treatment.

BS DEGREE IN CIVIL ENGINEERING

CEE offers an innovative and challenging BS engineering curriculum that is designed to provide significant flexibility to the student. Specific details and typical course layouts by semester can be found at the departmental **website: ceve.rice.edu**.

The main features of the ABET accredited BS in civil engineering are as follows:

2 DEPARTMENTS / Civil and Environmental Engineering

- Seven core courses (23 hours) primarily aimed at introduction to civil and environmental engineering, followed by 10 courses (30 hours) that represent the four thrust areas within CEE, with at least four courses from one thrust area.
- The total required CEE courses are kept to a minimum level of 51 hours to provide flexibility to the student.
- Select 12 credit hours for your focus area. Select 6 credit hours from each of the three remaining areas.
- The thrust areas include:
 - (1) environmental engineering (air and water quality, transport theory, modeling, and energy)
 - (2) hydrology and water resources (watershed and aquifer management, flood prediction, data analysis, GIS)
 - (3) structural engineering and mechanics (structural analysis, mechanics, design, matrix methods)
 - (4) urban infrastructure and management (transportation systems, complex urban systems, soil mechanics, engineering economics, management)
- A choice of free electives (6 hours) and recommended electives (9) to allow maximum flexibility for students to choose from an approved list of courses
- General science (39 hours) courses cover mathematics, physics, and chemistry
- Distribution (24 hours) courses as per university requirements. A total of at least 132 hours are required for graduation with a BS (see detailed list below). Additional features of the BS curriculum include:
 - Freshman/sophomore year courses that introduce fundamentals of CEE primarily targeted at students with diverse science, engineering, and humanities backgrounds (CEVE 101, 201, 211, 310, 311, 312)
 - Special-topics course available in the final year to help attract the best students to perform undergraduate research in the department.
 - Engineers Without Borders (EWB) is an important component of the program. This exciting new endeavor allows undergraduates to have an experience in a developing country where they are able to actually design and build a project to help society. Students have been attracted to the program in large numbers. (See ceve.rice.edu)

Course Requirements

General Science Requirements (* or an equivalent approved course)

CAAM 210 *Introduction to Engineering Comp* (3)
CAAM 335* *Matrix Analysis* (3)
CHEM 121 *General Chemistry with Lab* (4)
CHEM 122 *General Chemistry with Lab* (4)
CHEM 211 or PHY 201 or BIOS 201 (3)
MATH 101 *Single Variable Calculus I* (3)
MATH 102 *Single Variable Calculus II* (3)
MATH 211 *Ordinary Differential Equations* (3)
MATH 212 *Multivariable Calculus* (3)
PHYS 101 *Mechanics with Lab* (3)
PHYS 102 *Electricity and Magnetism with Lab* (4)
STAT 312 *Probability and Statistics* (3)

CEE Core Requirements (23 credits)

CEVE 101 (F) *Fundamentals of CEE* (3)
CEVE 211 (F) *Engineering Mechanics* (3)
CEVE 310/510 (F) *Environmental Eng. Processes* (3)
CEVE 311 (S) *Mechanics of Solids and Structures* (3)
CEVE 312 (S) *Strength of Materials Lab* (1)
CEVE 363 (F) *Fluid Mechanics* (3)
CEVE 401 (F) *Environmental Chemistry Lab* (4)
CEVE 480 (F) *Introduction to Senior Design* (1)
CEVE 481(S) *Senior Design* (3)

Area I Environmental Engineering (select six approved hours)

CEVE 302 (S) *Energy and the Environment* (3)
 CEVE 308 (S) *Air Pollution Control* (3)*
 CEVE 406 (S) *Environmental Law* (3)
 CEVE 411 (F) *Atmospheric Processes* (3)
 CEVE 434/534 (F) *Fate and Transport of Contaminants in the Environment* (3)
 Or any approved environmental course in CEE/CENG

Area II Hydrology and Water Resources (select six approved hours)

CEVE 412 (S) *Hydrology and Watershed Analysis* (3)
 CEVE 415/515 (F) *Water Resources* Engineering and Planning* (3)
 CEVE 418 (F) *Quantitative Hydrogeology* (3)
 CEVE 450 (S) *Remote Sensing* (3)
 CEVE 451 (F) *Analysis of Environmental Data* (3)
 CEVE 453 (F) *Geographical Information Science* (3)
 CEVE 512 (S) *Hydrologic Design Lab* (3)
 Or any approved course in CEE

Area III Structural Engineering and Mechanics (select six approved hours)

CEVE 304 (S) *Structural Analysis* (3)
 CEVE 400 (S) *Advanced Mechanics of Materials* (3)
 CEVE 405 (S) *Steel Design* (3)
 CEVE 407 (F) *Reinforced Concrete Design* (3)

CEVE 408 (F) *Structures Lab* (1)
 CEVE 427 (F) *Matrix Methods in Structural Mechanics* (3)
 CEVE 476 (S) *Structural Dynamic Systems* (3)*
 CEVE 496 (S) *Offshore and Marine Systems* (3)*
 Or any approved structures/mechanics course in CEE/MECH

Area IV Urban Infrastructure and Management (select six approved hours)

CEVE 313 (S) *Uncertainty and Risk Assessment* (3)
 CEVE 322 (F) *Engineering Economics* (3)
 CEVE 452 (S) *Urban Transportation Systems* (3)
 CEVE 460/560 (F) *Bridge Engineering and Extreme Events* (3)
 CEVE 470 (F) *Basic Soil Mechanics* (4)
 CEVE 479/505 (F) *Engineering Project Management* (3)
 CEVE 492 (F) *Complex Urban Systems* (3)
 Or any approved urban infrastructure and management course in CEE/MGMT/ECON/CAAM/STAT

List of CEE Recommended Elective Courses:

CEVE 302, 306, 315, 320, 404, 417, 454, 490, 495, 499
 (others listed on website)

*offered alternate years

ABET PROGRAM OBJECTIVES

(See website at ceve.rice.edu/ for additional information.)

1. Develop/demonstrate strong problem-solving and communication skills
2. Achieve leadership position in technical or managerial area
3. Demonstrate initiative and innovative thinking in project work
4. Maintain a keen awareness of ethical, social, environmental, and global concerns
5. Remain engaged in continuing learning, including advanced degrees
6. Prepare for a Professional Engineering License

ABET, Inc. III Market Place, Suite 1050
 Baltimore, MD 21202-4012
 Phone: 410-347-7700
 Email: eac@abet.org
 Website: <http://www.abet.org>

BA DEGREE IN ENVIRONMENTAL ENGINEERING SCIENCES

The BA degree in Environmental Engineering Sciences is designed to provide access to topics of common interest to students across the disciplines at Rice University. It is tailored to the specific needs of each student by discussion with and approval by the CEE departmental advisor(s). An advisor will be assigned by the CEE department chair, normally during the first year of study.

Five core courses and one lab, plus seven courses in a focused specialty area (example study areas listed below) of study, are required; total CEE requirements approximately 39 hours. In addition, each student is responsible for satisfying the university distribution requirements (24 hours) and additional electives for a total of at least 120 hours for graduation with a BA in environmental engineering sciences.

Students are encouraged, although not required, to double major in their focus specialty area.

The coherent and complete core curriculum is designed to give Rice undergraduate students a consistent technological literacy through the lens of civil and environmental engineering and to prepare students for graduate school in engineering, various sciences (depending on focus), economics, business MBA, political science, law, or medicine. Select students will be invited to finish an **accelerated MS/PhD degree** in the CEE department at Rice (meet with your advisor or department chair for details). Those students who want to obtain an ABET accredited engineering degree must follow a BS degree program in one of the engineering disciplines, including CEE.

A student must demonstrate proficiency in the basic concepts of mathematics, computation, chemistry, and physics. Generally, this will require that these subjects were studied previously, e.g., AP exams or concurrent enrollment with CEVE 101 or 201

Core courses required for all BA

Environmental Engineering Science majors:

CEVE 101 *Fundamentals of CEE* (3)

CEVE 201 (or 30X) *Urban and Environmental Systems* (4)*

CEVE 203 *Environmental Engineering Processes* (3)*

CEVE 401 *Intro to Environmental Chemistry* (4)*

CEVE 402 *Laboratory to accompany CEVE 203 and 401* (3)

CEVE 412 *Hydrology and Watershed Analysis* (3)

* Courses with laboratories

Typical “focus specialty areas” might include (subject to advisor approval of the specific focus and courses), but are not limited to, the following:

1. Environmental Engineering;
2. Earth Science;
3. Biology;
4. Chemical Engineering;
5. Chemistry;
6. Economics;
7. Management

BA DEGREE IN CIVIL ENGINEERING

The BA degree in civil engineering is designed to provide access to topics of common interest to students across the disciplines at Rice University. It is tailored to the specific needs of each student by discussion with and approval by the CEE departmental advisor. And advisor will be assigned by the CEE department chair, normally during the first year of study. For the BA degree in civil engineering, students must have a total of at least 120 hours. A student must demonstrate proficiency in the basic concepts of mathematics, computation, chemistry, and physics. Generally, this will require subjects studied previously, e.g., AP exams. The BA degree in civil engineering requires 21 hours of general math and science courses, 25 hours of core civil engineering courses, and 74 hours of electives (distribution courses 24 hours) and remaining open or free electives 50 hours). Students are encouraged, although not required, to double major in their focus specialty area.

The coherent and complete core curriculum is designed to give Rice undergraduate students a consistent technological literacy through the lens of

civil and environmental engineering and to prepare students for graduate school in engineering. Those students who want to obtain an ABET accredited engineering degree must follow a BS degree in the civil engineering program.

The CE subtrack, requires 21 hours of general math and science courses, 25 hours of core civil engineering courses, and 74 hours of electives (distribution courses 24 hours, and remaining open or free electives 50 hours):

Required general math and science courses		CEVE 312 <i>Strength of Materials</i>	1*
MATH 101 <i>Single Variable Calculus I</i>	3	CEVE 371 <i>Fluid Mechanics</i>	3
MATH 102 <i>Single Variable Calculus II</i>	3	* Laboratory	
MATH 211 <i>Ordinary Differential Equations</i>	3	Total:	13 hrs
[MATH 212 or 221 recommended]		Any four civil engineering courses from the following:	
PHYS 101* <i>Mechanics with Lab</i>	3	CEVE 302 <i>Sustainable Design</i>	3
PHYS 102* <i>Electricity and Magnetism with Lab</i>	3	CEVE 304 <i>Structural Analysis</i>	3
One of: COMP 110, CAAM 210, CAAM 335	3	CEVE 322 <i>Engineering Economics for Engineers</i>	3
One of: BIOS 122, CHEM 121/122, ELEC 242, MECH 200, MSC1 301	3	CEVE 405 <i>Steel Design</i>	3
* or equivalent		CEVE 407 <i>Reinforced Concrete Design</i>	3
Total:	21 hrs	CEVE 412 <i>Hydrology and Watersheds</i>	3
Required core civil engineering courses		CEVE 427 <i>Matrix Methods in Structural Mechanics</i>	3
CEVE 101 <i>Fundamentals of CEE</i>	3	CEVE 452 <i>Urban Transportation Systems</i>	3
CEVE 211 <i>Engineering Mechanics</i>	3	CEVE 470 <i>Basic Soil Mechanics</i>	4
CEVE 311 <i>Mechanics of Solids and Structures</i>	3	Total:	12 hrs

Engineers Without Borders (EWB) (CEVE 315) is an important component of the CEE program. This exciting new endeavor allows undergraduates to have an experience in a developing country, where they are able to actually design and build a project to help society. Students have been attracted to the program in large numbers.

DEGREE REQUIREMENTS FOR MCEE, MS, AND PHD

Admission—Applicants pursuing graduate education in environmental engineering or hydrology should have preparation in mathematics, science, and engineering or related courses. A BS degree or degree in natural science is preferred. Applicants pursuing graduate education in structural engineering, structural mechanics, and geotechnical engineering should have a BSCE with a significant emphasis on structural engineering, but students with other undergraduate degrees may apply if they have adequate preparation in mathematics, mechanics, and structural analysis and design. Applicants for graduate degrees should have a BS or BA in related areas of science and engineering. Successful applicants typically have at least a 3.00 (B) grade point average in undergraduate work and high Graduate Record Examination (GRE) scores. For general university requirements, see Admission to Graduate Study and Graduate Degrees (Graduate Student section, pages 3–4).

MS Program—The Master of Science degree is offered in both civil engineering and environmental engineering. For general university requirements, see Graduate Degrees (Graduate Student section, pages 3–4). To earn a MS degree, students must:

- Complete at least 24 semester hours of approved courses. For students studying environmental engineering, this must include one course each in

environmental chemistry, water treatment, hydrology, and air quality. For students studying civil, structural engineering, and mechanics, this must include one course each in structural engineering, mechanics, advanced mathematics, and dynamic systems (comparable course work completed previously may be substituted for the core courses).

- Select a thesis committee according to department requirements and conduct original research in consultation with the committee.
- Present and defend in oral examination an approved research thesis.

Students take the oral exam only after the committee determines the thesis to be in a written format acceptable for public defense. Normally, students take two academic years and the intervening summer to complete the degree.

Students intending to extend their studies into the PhD degree program should note that the department does not grant an automatic MS degree to candidates who have not written a satisfactory master's thesis.

MBA/MCEE Program—For general university requirements, see Graduate Degrees (Graduate Student section, pages 3–4). See also Management and Accounting (in Departments & Programs section). To earn a MBA/MCEE degree, students must:

- Complete 24 semester hours of civil engineering courses.
- Complete 52 semester hours of business administration courses.

MCEE Program—The Master of Civil and Environmental Engineering (MCEE) is a professional nonthesis degree requiring 30 hours of study. Students who have a BS or BA degree in any field of engineering or related study may apply (see Graduate Degrees in Graduate Students section, pages 3–4) and complete 30 hours of graduate level courses or courses co-listed by the CEE department. Other graduate courses from other departments might count towards the MCEE degree, but need prior approval by a CEE faculty advisor. Depending on their background, some students may need to fulfill prerequisites or take remedial engineering courses to earn the MCEE degree. Refer to our website, www.ceve.rice.edu.

PhD Program—To earn a PhD degree, candidates must successfully accomplish the following (spending at least four semesters in full-time study at Rice). (See candidacy, oral examinations, and the thesis in Graduate Students section, pages 13–15).

- Complete 90 semester hours of approved credits past BS (60 semester hours past MS) with high standing (See guidelines on our website, www.ceve.rice.edu.)
- Pass a preliminary written examination in civil and environmental engineering (See guidelines on our website, www.ceve.rice.edu.)
- Pass a qualifying examination on course work, proposed research, and related topics
- Complete a dissertation indicating an ability to do original and scholarly research
- Pass a formal public oral examination on the thesis and related topics. PhD candidates in civil and environmental engineering take the preliminary exam, administered by department faculty, after two semesters of course work. Candidates who pass this exam then form a doctoral committee according to department requirements. The qualifying examination administered by the doctoral committee after candidates develop a

research proposal evaluates their preparation for the proposed research and identifies any areas requiring additional course work or study. As part of the advanced degree training, we also may require students to assist the faculty in undergraduate courses and laboratory instructions.