

# CIVIL AND ENVIRONMENTAL ENGINEERING

## THE GEORGE R. BROWN SCHOOL OF ENGINEERING

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### DEGREES OFFERED: BA, MCE, MEE, MES, MS, PHD

Civil and environmental engineering (CEVE) 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 complete a double major with any other Rice University major. Three nonthesis graduate degrees (MCE, MEE, and MES) are 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

The Department of Civil and Environmental Engineering (CEVE) 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: <http://ceve.rice.edu>.

The main features of the ABET accredited BS in Civil Engineering are as follows:

- 6 core courses and 2 labs (21 hours) primarily aimed at introduction to civil and environmental engineering, followed by 8 courses (24 hours) that represent the 4 thrust areas within CEVE
- The total required CEVE courses are kept to a minimum level of 45 hours to provide maximum flexibility to the student, as well as 2 additional focus area elective courses
- The thrust areas include (1) environmental engineering (air and water quality, transport theory and modeling); (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, geotechnical engineering, engineering economics, management)

- A choice of free electives (18 hours) to allow maximum flexibility for students to choose from a approved list of courses
- General science (39 hours) courses involve 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 CEVE primarily targeted at students with diverse science, engineering, and humanities backgrounds (CEVE 101, 201, 203, 211, and 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) (CEVE 315) 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.

### Course Requirements

#### **General Science Requirements (\* or an equivalent approved course)**

MATH 101 *Single Variable Calculus I* (3)  
 MATH 102 *Single Variable Calculus II* (3)  
 CHEM 121 *General Chemistry with Lab* (4)  
 CHEM 122 *General Chemistry with Lab* (4)  
 PHYS 101 *Mechanics with Lab* (3)  
 PHYS 102 *Electricity and Magnetism with Lab* (4)  
 MATH 211 *Ordinary Differential Equations* (3)  
 MATH 212 *Multivariable Calculus* (3)  
 CAAM 210 *Introduction to Engineering Comp* (3)  
 STAT 310\* *Probability and Statistics* (3)  
 CAAM 335\* *Matrix Analysis* (3)  
 CHEM 211 or PHY 201 or BIOS 201 (3)

#### **CEVE Core Requirements (21 credits)**

CEVE 101 (F) *Fundamentals of CEVE* (3)  
 CEVE 203 (F) *Environmental Eng. Processes* (3)  
 CEVE 211 (F) *Engineering Mechanics* (3)  
 CEVE 311 (S) *Mechanics of Solids and Structures* (3)  
 CEVE 312 (S) *Strength of Materials Lab* (1)  
 CEVE 371 (F) *Fluid Mechanics* (3)  
 CEVE 480 (S) *Senior Design Project* (4)

#### **Area I Environmental Engineering (select 6 approved hours)**

CEVE 401 (F) *Environmental Chemistry* (3)

CEVE 402 (F) *Environmental Chemistry Lab* (1)  
 CEVE 406 (S) *Environmental Law* (3)  
 CEVE 411 (S) *Air Resources Management* (3)  
 CEVE 434 (F) *Fate and Transport of Contaminants in the Environment* (3)  
 Or any approved environmental course in CEVE/CENG

#### **Area II Hydrology and Water Resources (select 6 approved hours)**

CEVE 412 (S) *Hydrology and Watershed Analysis* (3)  
 CEVE 418 *Quantitative Hydrogeology*  
 CEVE 443 (F) *Atmospheric Science* (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 computational course in CEVE/CAAM/ESCI

#### **Area III Structural Engineering and Mechanics (select 6 approved hours)**

CEVE 304 (S) *Structural Analysis* (3)  
 CEVE 400 *Advanced Mech of Materials*  
 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)

Or any approved structures/mechanics course in CEVE/MECH

**Area IV Urban Infrastructure and Management (select 6 approved hours)**

CEVE 201 (F) *Urban and Environmental Systems* (4)

CEVE 322 (F) *Engineering Economics* (3)

CEVE 452 (S) *Urban Transportation Systems* (3)

MGMT 750 (F) *Management for Science and Engineering* (3)

MGMT 751 (S) *Management for Science and Engineering* (3)

CEVE 470 (F) *Infrastructure Geotechnical Engineering* (4)

Or any approved urban infrastructure and management course in CEVE/MGMT/ECON

**List of CEVE Recommended Elective Courses:**

CEVE 308, 315, 316, 400, 417, 454, 479, 490, 499

**ABET PRORAM OBJECTIVES**

(see website at <http://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

**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 CEVE departmental advisor. An advisor will be assigned by the CEVE department chair, normally during the 1st year of study. Five core courses, plus 7 courses in a focused specialty area (see below for example curricula) of study are required; total CEVE 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. Although not required, students are encouraged 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 CEVE 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 CEVE.

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.

Seven courses from approved electives, including 4 courses from 1 specific focus area; 4 of these 7 courses must be 300, or above, and 2 of these upper-division courses must be from the CEVE curriculum.

**Five Core courses required for all BA Environmental Engineering Science majors:**CEVE 101 *Fundamentals of CEVE* (3)CEVE 201 *Urban and Environmental Systems* (4)\*CEVE 203(204) *Environmental Engineering Processes* 4\*CEVE 401 *Intro Environmental Chemistry* (4)CEVE 412 *Hydrology and Watershed Analysis* (3)

\* Courses with laboratories

**Typical “focus specialty areas” might include (subject to advisor approval):**

1. Environmental Engineering: CEVE 406, 411, 434; ESCI 451 plus 3 approved electives
2. Chemical Engineering: CENG 301, 390, 401, 402; CEVE 411, 434, 443
3. Chemistry: CHEM 211, 212; CEVE 406, 511 plus 3 approved electives
4. Economics: ECON 211, 212, 370, 450, 461; CEVE 406, 411
5. Management: ECON 211, 212, 461; ACCO. 305; POLI 336; CEVE 406, 411

Engineers Without Borders (EWB) (CEVE 315) is an important component of the CEVE 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

**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 CEVE departmental advisor. An advisor will be assigned by the CEVE department chair, normally during the first year of study. For the BA degree in civil engineering the 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). Although not required, students are encouraged 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 civil engineering program.

**Required general math and science courses**

MATH 101 <i>Single Variable Calculus I</i>	3
MATH 102 <i>Single Variable Calculus II</i>	3
MATH 211 <i>Ordinary Differential Equations</i>	3
PHYS 101* <i>Mechanics with Lab</i>	3
PHYS 102* <i>Electricity and Magnetism with Lab</i>	3
One of [COMP 110, CAAM 210, CAAM 335]	3
One of [BIOS 122, CHEM 121/122, ELEC 242, MECH200, MSC1 301]	3
* or equivalent [MATH 212 or 221 recommended]	
<b>Total:</b>	<b>21 hrs</b>

**Required core civil engineering courses**

CEVE 101 <i>Fundamentals of CEVE</i>	3
CEVE 211 <i>Engineering Mechanics</i>	3
CEVE 311 <i>Mechanics of Solids and Structures</i>	3
CEVE 312 <i>Strength of Materials</i>	1*
CEVE 371 <i>Fluid Mechanics</i>	3
* Laboratory	
<b>Total:</b>	<b>13 hrs</b>
<b>Any 4 civil engineering courses from the following:</b>	
CEVE 202 <i>Environmental Eng. Processes</i>	3

CEVE 304 Structural Analysis	3	CEVE 427 Matrix Methods in Structural Mechanics	3
CEVE 322 Engineering Economics for Engineers	3	CEVE 452 Urban Transportation Systems	3
CEVE 405 Steel Design	3	CEVE 470 Infrastructure Geotechnical Engineering	4
CEVE 407 Reinforced Concrete Design	3	<b>Total:</b>	<b>12 hrs</b>
CEVE 412 Hydrology and Watersheds	3		

### DEGREE REQUIREMENTS FOR MCE, MEE, MES, 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 Graduate Degrees and Admission to Graduate Study (s 56–58).

**MS Program**—The Master of Science degree is offered in both civil engineering and environmental engineering. For general university requirements, see Graduate Degrees (s 57–58). To earn a MS degree, students must:

- Complete at least 24 semester hours of approved courses. For students studying environmental engineering, this must include 1 course each in environmental chemistry, water treatment, hydrology, and air quality. For students studying civil, structural engineering, and mechanics, this must include 1 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 2 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.

**MCE Program**—The Master of Civil Engineering (MCE) is a professional nonthesis degree requiring 30 hours of study. Students with a BS in civil engineering are eligible to apply. (see Graduate Degrees s 57–58). To earn an MCE degree, students must complete 30 semester hours of approved courses.

**MBA/MCE Program**—For general university requirements, see Graduate Degrees (pages 57–58). See also Management and Accounting (pages 200–211). To earn a MBA/MCE degree, students must:

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

**MEE Program**—The Master of Environmental Engineering (MEE) is a professional nonthesis degree requiring 30 hours of study. Students who have a BS degree in any field of engineering may apply (see Graduate Degrees pages 57–58).

**MES Program**—The Master of Environmental Science (MES) is a professional nonthesis degree requiring 30 hours of study. To enter the MES program, applicants must have a BA or BS degree in any of the natural or physical sciences (see Graduate Degrees pages 57–58).

**PhD Program**—To earn a PhD degree, candidates must successfully accomplish the following (spending at least 4 semesters in full-time study at Rice). (See candidacy, oral examinations, and the thesis (pages 65–68).

- Complete 90 semester hours of approved course work past BS (60 semester hours past MS) with high standing.
- Pass a preliminary written examination in civil and environmental engineering.
- 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 2 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.