ARCHITECTURAL ENGINEERING - BACHELOR OF SCIENCE (BSARE)

Architectural engineering is the application of engineering principles and technology to building design and construction. Architectural engineering combines aspects of electrical, mechanical, and civil engineering to design integrated systems for buildings. Building systems include heating, ventilating and air conditioning (HVAC) systems; illumination and electrical systems; materials and structural systems; and construction methods applied to buildings.

The Bachelor of Science degree program is administered by the Department of Civil, Environmental and Architectural Engineering. Students also take a course in architectural history and theory from the Environmental Design (ENVD) Program.

Requirements

Program Requirements
To earn a bachelor’s degree in architectural engineering, students must complete the curriculum in the undergraduate major program as outlined below. For up-to-date program requirements, visit the Bachelor of Science in Architectural Engineering (https://www.colorado.edu/ceae/current-students/undergraduate-studies/architectural-engineering/) webpage. Note: Some variations may be possible; see an architectural engineering academic advisor.

In addition, students must meet the general undergraduate degree requirements of the College of Engineering and Applied Science (https://www.colorado.edu/engineering-advising/get-your-degree/graduation-requirements/) and all graduation requirements specified on the CEAE Department website.

Students may earn a Bachelor of Science in Architectural Engineering and a Bachelor of Science in Integrated Design Engineering with an architectural engineering emphasis.

Prerequisites and Passing Grades
The minimum passing grade for a course that is a prerequisite or corequisite is C-. The minimum passing grade for a course that is not specifically a prerequisite or corequisite for another required course is D-.

It is the student's responsibility to communicate with the department if summer coursework and/or transfer credit will be used to meet a prerequisite requirement.

Required Courses and Credits

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREN 1027</td>
<td>Engineering Drawing</td>
<td>3</td>
</tr>
<tr>
<td>AREN 1316 or ASEN 1000 or BMEN 1000 or CHEN 1300 or CSCI 1000</td>
<td>Introduction to Architectural Engineering or Exploring Biomedical Engineering or Introduction to Aerospace Engineering Sciences or Introduction to Chemical and Biological Engineering or Computer Science as a Field of Work and Study</td>
<td>1</td>
</tr>
<tr>
<td>AREN 2050 or CVEN 1317 or ECEN 1100 or EVEN 1000</td>
<td>Building Materials and Systems or Introduction to Civil and Environmental Engineering or Exploring ECE or Introduction to Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>AREN 2110 or ASEN 2702 or EVEN 3012 or GEEN 3852 or MCEN 3012</td>
<td>Thermodynamics or Introduction to Thermodynamics and Aerodynamics or Thermodynamics for Environmental Science and Engineering or Thermodynamics for Engineers or Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>AREN 2120 or CVEN 3313 &amp; AREN 2121</td>
<td>Fluid Mechanics and Heat Transfer or Theoretical Fluid Mechanics and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>AREN 3010</td>
<td>Energy Efficient Buildings</td>
<td>3</td>
</tr>
<tr>
<td>AREN 3040</td>
<td>Circuits for Architectural Engineers</td>
<td>3</td>
</tr>
<tr>
<td>AREN 3080</td>
<td>Architectural Design Studio 1</td>
<td>3</td>
</tr>
<tr>
<td>AREN 3540</td>
<td>Illumination I</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4110</td>
<td>Building Energy Systems Engineering</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4318</td>
<td>Architectural Engineering Design 1</td>
<td>5</td>
</tr>
<tr>
<td>AREN 4319</td>
<td>Architectural Engineering Design 2</td>
<td>2</td>
</tr>
<tr>
<td>AREN 4506</td>
<td>Pre-construction Estimating and Scheduling</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4550</td>
<td>Illumination 2</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4570</td>
<td>Building Electrical Systems Design 1</td>
<td>3</td>
</tr>
<tr>
<td>CSCI 1200 or ASEN 1320 or CHEN 1310 or CSCI 1300 or ECEN 1310 or MCEN 1030</td>
<td>Introduction to Computational Thinking or Aerospace Computing and Engineering Applications or Introduction to Engineering Computing or Computer Science 1: Starting Computing or C Programming for ECE or Introduction to Engineering Computing</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 2017</td>
<td>Excel Matlab R Primer</td>
<td>1</td>
</tr>
<tr>
<td>CVEN 2121 or ASEN 2401 or ASEN 2701 or GEEN 2851 or MCEN 2023</td>
<td>Analytical Mechanics 1 or Statics or Introduction to Statics, Structures, and Materials or Statics for Engineers or Statics and Structures</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 3161 or MCEN 2063</td>
<td>Mechanics of Materials 1 or Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 3246</td>
<td>Introduction to Construction</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 3525</td>
<td>Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 4455 or CVEN 4555</td>
<td>Steel Design or Reinforced Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>GEEN 1400</td>
<td>Engineering Projects</td>
<td>3</td>
</tr>
<tr>
<td>or ASEN 1400 or ASEN 1403 or CHEN 1400 or ECEN 1400</td>
<td>Gateway to Space or Introduction to Rocket Engineering or Drugs, Driving and Dynamic Processes or Introduction to Digital and Analog Electronics</td>
<td>12</td>
</tr>
</tbody>
</table>

Technical Electives
At least two technical electives must be selected from the specialization lists below. The remaining technical electives may be any upper-division AREN or CVEN course or any course on the approved Technical Elective List. ²

Construction Engineering & Management
- AREN 4315 Design of Masonry Structures
- AREN 4606 Construction Project Execution and Control (strongly recommended)
- CVEN 3256 Construction Equipment and Methods (strongly recommended)
- CVEN 3708 Geotechnical Engineering 1
- CVEN 3718 Geotechnical Engineering 2
- CVEN 4565 Design of Wood Structures

Lighting & Electrical Systems
- AREN 4130 Optical Design for Illumination and Solid State Lighting
- AREN 4530 Advanced Lighting Design
- AREN 4560 Luminous Radiative Transfer
- AREN 4580 Daylighting
- AREN 4620 Adaptive Lighting Systems

Mechanical Systems
- AREN 4010 Energy System Modeling and Control
- AREN 4040 Building Energy Audits
- AREN 4890 Sustainable Building Design
- AREN 4990 Compu Fluid Dynamics (CFD) Analysis for Built/Natural Envmnts
- AREN 5080 Computer Simulation of Building Energy Systems

Structural Systems
- AREN 4315 Design of Masonry Structures
- AREN 5660 Embodied Carbon in Buildings
- CVEN 4161 Mechanics of Materials 2
- CVEN 4545 Steel Design ³
- or CVEN 4555 Reinforced Concrete Design
- CVEN 4565 Design of Wood Structures
- CVEN 4728 Foundation Engineering

Required Mathematics Courses
- APPM 1350 Calculus 1 for Engineers 4
- or MATH 1300 Calculus 1 4
- or APPM 1345 Calculus 1 with Algebra, Part B 4
- APPM 1360 Calculus 2 for Engineers 4
- or MATH 2300 Calculus 2 4
- APPM 2350 Calculus 3 for Engineers 4
- or MATH 2400 Calculus 3 4
- APPM 2360 Introduction to Differential Equations with Linear Algebra 4
- or MATH 2130 & MATH 3430 Introduction to Linear Algebra for Non-Mathematics Majors and Ordinary Differential Equations 4
- or MATH 2135 & MATH 3430 Introduction to Linear Algebra for Mathematics Majors and Ordinary Differential Equations 4

Required Science Courses
- CHEM 1114 Laboratory in General Chemistry 1 1
- or CHEM 1221 Engineering General Chemistry Lab 1
- or PHYS 1140 Experimental Physics 1 1
- CHEN 1201 General Chemistry for Engineers 1 4
- or ASEN 1022 Materials Science for Aerospace Engineers 4
- or CHEN 1211 Accelerated Chemistry for Engineers 4
- or CHEM 1113 General Chemistry 1 4
- or MCEN 1024 Chemistry for Energy and Materials Science 4
- PHYS 1110 General Physics 1 4
- or PHYS 1115 General Physics 1 for Majors 4
- PHYS 1120 General Physics 2 4
- or PHYS 1125 General Physics 2 for Majors 4

Humanities, Social Sciences and Writing

Writing
- College-approved writing course. ⁴

Humanities & Social Sciences
- ARCH 3214 History and Theory of Architecture 2 15
- Other approved Humanities & Social Sciences Electives. At least 6 credits (including ARCH 3214) must be at the upper-division level (3000 level or higher). ⁴

Free Electives
- 3

Total Credit Hours
- 128

1 Students who do not take a first-year projects course may substitute a basic engineering elective: any 3-credit technical course offered in ASEN, AREN, APPM, CHEN, COEN, CVEN, CSCI, ECEN, EMEN, EVEN, GEEN, MCEN, or other course approved by the CEAE Curriculum Committee. Remedial courses (such as precalculus) or courses approved as Humanities & Social Sciences electives may not be used.

2 The approved Technical Elective List can be found on the CEAE Department website (https://www.colorado.edu/ceae/current-students/undergraduate-studies/architectural-engineering/).

3 Either CVEN 4545 or CVEN 4555 may be taken as a technical elective — whichever course is not used to fulfill the required structural design course.

4 Refer to the College’s approved list of courses that fulfill the Humanities, Social Sciences and Writing Requirement (https://www.colorado.edu/engineering-advising/get-your-degree/degree-requirements/humanities-social-sciences-and-writing-requirements/).

Sample Four-Year Plan of Study

Year One

Fall Semester
<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPM 1350 Calculus 1 for Engineers 4</td>
</tr>
<tr>
<td>AREN 1316 Introduction to Architectural Engineering 1</td>
</tr>
<tr>
<td>CHEM 1114 or PHYS 1140 Laboratory in General Chemistry 1 ³ or Experimental Physics 1 1</td>
</tr>
<tr>
<td>CHEN 1201 General Chemistry for Engineers 1 4</td>
</tr>
<tr>
<td>CSCI 1200 Introduction to Computational Thinking 3</td>
</tr>
<tr>
<td>COEN 1830 Special Topics (First-Year Seminar) 1</td>
</tr>
<tr>
<td>Humanities &amp; Social Sciences elective ¹ 2</td>
</tr>
</tbody>
</table>

Spring Semester
<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPM 1360 Calculus 2 for Engineers 4</td>
</tr>
</tbody>
</table>

¹ Students who do not take a first-year projects course may substitute a basic engineering elective: any 3-credit technical course offered in ASEN, AREN, APPM, CHEN, COEN, CVEN, CSCI, ECEN, EMEN, EVEN, GEEN, MCEN, or other course approved by the CEAE Curriculum Committee. Remedial courses (such as precalculus) or courses approved as Humanities & Social Sciences electives may not be used.

² The approved Technical Elective List can be found on the CEAE Department website (https://www.colorado.edu/ceae/current-students/undergraduate-studies/architectural-engineering/).

³ Either CVEN 4545 or CVEN 4555 may be taken as a technical elective — whichever course is not used to fulfill the required structural design course.

⁴ Refer to the College’s approved list of courses that fulfill the Humanities, Social Sciences and Writing Requirement (https://www.colorado.edu/engineering-advising/get-your-degree/degree-requirements/humanities-social-sciences-and-writing-requirements/).
AREN 1027  Engineering Drawing  3  
PHYS 1110  General Physics 1  4  
First-Year Projects course or Basic Engineering Elective  3  
Humanities & Social Sciences elective  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

Year Two

Fall Semester

APPM 2350  Calculus 3 for Engineers  4  
AREN 2050  Building Materials and Systems  3  
AREN 2110  Thermodynamics  3  
CVEN 2121  Analytical Mechanics 1  3  
PHYS 1120  General Physics 2  4  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

Spring Semester

APPM 2360  Introduction to Differential Equations with Linear Algebra  4  
AREN 2120  Fluid Mechanics and Heat Transfer  3  
AREN 3080  Architectural Design Studio 1  3  
AREN 3540  Illumination I  3  
CVEN 2017  Excel Matlab R Primer  1  
CVEN 3161  Mechanics of Materials 1  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

Year Three

Fall Semester

AREN 3010  Energy Efficient Buildings  3  
AREN 4550  Illumination 2  3  
CVEN 3246  Introduction to Construction  3  
CVEN 3525  Structural Analysis  3  
College-approved writing course  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
</tr>
</tbody>
</table>

Spring Semester

ARCH 3214  History and Theory of Architecture 2  3  
AREN 3040  Circuits for Architectural Engineers  3  
AREN 4110  Building Energy Systems Engineering  3  
AREN 4506  Pre-construction Estimating and Scheduling  3  
CVEN 4545  Steel Design  3  
or CVEN 4555  or Reinforced Concrete Design  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
</tr>
</tbody>
</table>

Year Four

Fall Semester

AREN 4318  Architectural Engineering Design 1  5  
AREN 4570  Building Electrical Systems Design 1  3  
Humanities & Social Sciences elective  3  
Technical elective  3  
Technical elective  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

Spring Semester

AREN 4319  Architectural Engineering Design 2  2  
Free elective  3  
Humanities & Social Sciences elective  3  
Technical elective  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

Technical elective  3  

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
</tr>
</tbody>
</table>

Total Credit Hours  128  

1. Students may choose courses from the list of college-approved humanities and social sciences (HSS) electives (http://www.colorado.edu/engineering/academics/policies/hss/).
2. Students may choose a course from the list of college-approved writing courses (http://www.colorado.edu/engineering/academics/policies/hss/).
3. Students who choose PHYS 1140 will take it in Year Two or later (with or after PHYS 1120).

AREN Electives and Opportunities for Specialization

Upon consultation with their advisors, students select technical elective courses applicable to their areas of interest and specialization. The areas of specialization are construction engineering and management, mechanical systems, structural systems, and lighting and electrical systems.

Courses may be chosen from any emphasis area. At least two technical electives must be selected from this list. Some technical electives are offered intermittently and are not guaranteed to be offered every year.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREN 4315</td>
<td>Design of Masonry Structures</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4606</td>
<td>Construction Project Execution and Control</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 3256</td>
<td>Construction Equipment and Methods</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 3708</td>
<td>Geotechnical Engineering 1</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 3718</td>
<td>Geotechnical Engineering 2</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 4565</td>
<td>Design of Wood Structures</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4010</td>
<td>Energy System Modeling and Control</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4040</td>
<td>Building Energy Audits</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4890</td>
<td>Sustainable Building Design</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4990</td>
<td>Computer Fluid Dynamics (CFD) Analysis for Built/Natural Envmnts</td>
<td>3</td>
</tr>
<tr>
<td>AREN 5080</td>
<td>Computer Simulation of Building Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>AREN 4315</td>
<td>Design of Masonry Structures</td>
<td>3</td>
</tr>
<tr>
<td>AREN 5660</td>
<td>Embodied Carbon in Buildings</td>
<td>3</td>
</tr>
<tr>
<td>CVEN 4611</td>
<td>Mechanics of Materials 2</td>
<td>3</td>
</tr>
</tbody>
</table>
| CVEN 4545 | Steel Design | 3  
| or CVEN 4555 | or Reinforced Concrete Design | 3 |
| AREN 4130 | Optical Design for Illumination and Solid State Lighting | 3 |
Technical areas are: technical and non-technical areas.
The areas of knowledge that define these objectives include both
Areas of Knowledge

Engineering are:

The outcomes that students are expected to have attained upon
Student Outcomes

Program Educational Objectives
The educational objectives of the architectural engineering bachelor of

science degree program are to produce graduates capable of reaching

the following career goals within five years:

- Our alumni will build on the educational foundation gained through
  our program by establishing themselves in engineering, science or
  other professional careers.
- Our alumni will begin advancing the state-of-the-art of their
  profession including one of five core disciplines of the building
  industry: electrical systems, lighting systems, heating, ventilating and
  air conditioning (HVAC) systems, materials and structural systems,
  construction engineering and management.
- Our alumni will exercise leadership in their field.
- Our alumni will enhance the sustainability of the built environment.

Learning Outcomes

Non-technical areas include:

- Professional life, including methods of time and resource
  management and professional ethics.
- Processes and requirements of written and oral communication.
- Broad areas in the humanities and social sciences, including
  architectural history and language.

Bachelor's–Accelerated Master's Degree

Program(s)
The bachelor’s–accelerated master’s (BAM) degree program options offer
currently enrolled CU Boulder undergraduate students the opportunity
to receive a bachelor’s and master’s degree in a shorter period of time.

Students receive the bachelor’s degree first but begin taking graduate
coursework as undergraduates (typically in their senior year).

Because some courses are allowed to double count for both the
bachelor’s and the master’s degrees, students receive a master’s degree
in less time and at a lower cost than if they were to enroll in a stand-alone
master’s degree program after completion of their baccalaureate degree.
In addition, staying at CU Boulder to pursue a bachelor’s–accelerated
master’s program enables students to continue working with their
established faculty mentors.

BS in Architectural Engineering, MS in Architectural Engineering or Civil Engineering

Admissions Requirements

In order to gain admission to the BAM programs named above, a student
must meet the following criteria:

- Have a cumulative GPA of 3.000 or higher.
- Completion of all MAPS requirements and no deficiencies
  remaining (students admitted to CU Boulder prior to Summer 2023
  only).
- Have at least junior status within the bachelor’s degree program.

Program Requirements

Students may take up to and including 12 hours while in the
undergraduate program which can later be used toward the master’s
degree. However, only 6 credits may be double counted toward the
bachelor’s degree and the master’s degree. Students must apply to
graduate with the bachelor’s degree, and apply to continue with the

master's degree, early in the semester in which the undergraduate requirements will be completed.

Please see the BAM degree program (https://www.colorado.edu/ceae/current-students/undergraduate-studies/bsms-program/) webpage for more information.