

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.

Prerequisites and Passing Grades

The minimum passing grade for a course that is a prerequisite or corequisite for another required course 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

Code	Title	Credit Hours
Required Courses		
AREN 1027	Engineering Drawing	3
AREN 1316	Introduction to Architectural Engineering	1
or ASEN 1000	Introduction to Aerospace Engineering Sciences	
or BMEN 1000	Exploring Biomedical Engineering	
or CHEN 1300	Introduction to Chemical Engineering	
or CSCI 1000	Computer Science as a Field of Work and Study	
or CVEN 1317	Introduction to Civil and Environmental Engineering	
or ECEN 1100	Exploring ECE	
or EVEN 1000	Introduction to Environmental Engineering	

AREN 2050	Building Materials and Systems	3
AREN 2110	Thermodynamics	3
or ASEN 2702	Introduction to Thermodynamics and Aerodynamics	
or GEEN 3852	Thermodynamics for Engineers	
or MCEN 3012	Thermodynamics	
AREN 2120	Fluid Mechanics and Heat Transfer	3
or CVEN 3313 & AREN 2121	Theoretical Fluid Mechanics and Heat Transfer	
AREN 3010	Energy Efficient Buildings	3
AREN 3040	Circuits for Architectural Engineers	3
AREN 3080	Architectural Design Studio 1	3
AREN 3540	Illumination I	3
AREN 4110	HVAC System Design	3
AREN 4318	Architectural Engineering Design 1	5
AREN 4319	Architectural Engineering Design 2	2
AREN 4506	Pre-construction Estimating and Scheduling	3
AREN 4550	Illumination 2	3
AREN 4570	Building Electrical Systems Design 1	3
CSCI 1200	Introduction to Computational Thinking	3
or ASEN 1320	Aerospace Computing and Engineering Applications	
or CHEN 1310	Introduction to Engineering Computing	
or CSCI 1300	Computer Science 1: Starting Computing	
or ECEN 1310	C Programming for ECE	
CVEN 2017	Excel Matlab R Primer	1
CVEN 2121	Analytical Mechanics 1	3
or ASEN 2701	Introduction to Statics, Structures, and Materials	
or GEEN 2851	Statics for Engineers	
or MCEN 2023	Statics and Structures	
CVEN 3161	Mechanics of Materials 1	3
or MCEN 2063	Mechanics of Solids	
CVEN 3246	Introduction to Construction	3
CVEN 3525	Structural Analysis	3
CVEN 4545	Steel Design	3
or CVEN 4555	Reinforced Concrete Design	
GEEN 1400	Engineering Projects ¹	3
or ASEN 1400	Gateway to Space	
or ASEN 1403	Introduction to Rocket Engineering	
or CHEN 1400	Drugs, Driving and Dynamic Processes	
or ECEN 1400	Introduction to Digital and Analog Electronics	

Technical Electives 12

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	
or APPM 1345	Calculus 1 with Algebra, Part B	
APPM 1360	Calculus 2 for Engineers	4
or MATH 2300	Calculus 2	
APPM 2350	Calculus 3 for Engineers	4
or MATH 2400	Calculus 3	
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	
or MATH 2135 & MATH 3430	Introduction to Linear Algebra for Mathematics Majors and Ordinary Differential Equations	
Required Science Courses		
CHEM 1114	Laboratory in General Chemistry 1	1
or CHEM 1221	Engineering General Chemistry Lab	
or PHYS 1140	Experimental Physics 1	
CHEN 1201	General Chemistry for Engineers 1	4
or ASEN 1022	Materials Science for Aerospace Engineers	
or CHEN 1211	Accelerated Chemistry for Engineers	
or CHEM 1113	General Chemistry 1	
or MCEN 1024	Chemistry for Energy and Materials Science	
PHYS 1110	General Physics 1	4
or PHYS 1115	General Physics 1 for Majors	
PHYS 1120	General Physics 2	4

or PHYS 1125	General Physics 2 for Majors	
Humanities, Social Sciences and Writing		
Writing		3
College-approved writing course from https://www.colorado.edu/engineering-advising/get-your-degree/degree-requirements/humanities-social-sciences-and-writing-requirements (https://www.colorado.edu/engineering-advising/get-your-degree/degree-requirements/humanities-social-sciences-and-writing-requirements/)		
Humanities & Social Sciences		15
ARCH 3214	History and Theory of Architecture 2	
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

- 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.
- The approved Technical Elective List can be found on the CEAE Department website (<https://www.colorado.edu/ceae/current-students/undergraduate-studies/architectural-engineering/>).
- 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.
- 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		Credit Hours
APPM 1350	Calculus 1 for Engineers	4
AREN 1316	Introduction to Architectural Engineering	1
CHEM 1114	Laboratory in General Chemistry 1 ³	1
or PHYS 1140	or Experimental Physics 1	
CHEN 1201	General Chemistry for Engineers 1	4
CSCI 1200	Introduction to Computational Thinking	3
Humanities & Social Sciences elective ¹		3
Credit Hours		16
Spring Semester		
APPM 1360	Calculus 2 for Engineers	4
AREN 1027	Engineering Drawing	3
PHYS 1110	General Physics 1	4
First-Year Projects course or Basic Engineering Elective		3
Humanities & Social Sciences elective ¹		3
Credit Hours		17

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
Credit Hours		17

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
Credit Hours		17

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 ²		3
Credit Hours		15

Spring Semester

ARCH 3214	History and Theory of Architecture 2	3
AREN 3040	Circuits for Architectural Engineers	3
AREN 4110	HVAC System Design	3
AREN 4506	Pre-construction Estimating and Scheduling	3
CVEN 4545 or CVEN 4555	Steel Design or Reinforced Concrete Design	3
Credit Hours		15

Year Four
Fall Semester

AREN 4318	Architectural Engineering Design 1	5
AREN 4570	Building Electrical Systems Design 1	3
Humanities & Social Sciences elective ¹		3
Technical elective		3
Technical elective		3
Credit Hours		17

Spring Semester

AREN 4319	Architectural Engineering Design 2	2
Free elective		3
Humanities & Social Sciences elective ¹		3
Technical elective		3
Technical elective		3
Credit Hours		14

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.

Code	Title	Credit Hours
Construction Engineering & Management		
AREN 4315	Design of Masonry Structures	3
AREN 4606	Construction Project Execution and Control	3
CVEN 3256	Construction Equipment and Methods	3
CVEN 3708	Geotechnical Engineering 1	3
CVEN 3718	Geotechnical Engineering 2	3
CVEN 4565	Design of Wood Structures	3
Students with an interest in construction are also encouraged to take CVEN 2012 as a Basic Engineering Elective or Free Elective		
Mechanical Systems		
AREN 4010	Energy System Modeling and Control	3
AREN 4040	Building Energy Audits	3
AREN 4890	Sustainable Building Design	3
AREN 4990	Compu Fluid Dynamics (CFD) Analysis for Built/Natural Envmnts	3
AREN 5080	Computer Simulation of Building Energy Systems	3
Structural Systems		
AREN 4315	Design of Masonry Structures	3
AREN 5660	Embodied Carbon in Buildings	3
CVEN 4161	Mechanics of Materials 2	3
CVEN 4545 or CVEN 4555	Steel Design ¹ Reinforced Concrete Design	3
CVEN 4565	Design of Wood Structures	3
CVEN 4728	Foundation Engineering	3
Lighting & Electrical Systems		
AREN 4130	Optical Design for Illumination and Solid State Lighting	3
AREN 4530	Advanced Lighting Design	3
AREN 4560	Luminous Radiative Transfer	3

AREN 4580	Daylighting	3
AREN 4620	Adaptive Lighting Systems	3

¹ CVEN 4545 or CVEN 4555, whichever course is *not* used to fulfill the required course in spring semester of year 3, may be taken as a technical elective.

Learning 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.

Student Outcomes

The outcomes that students are expected to have attained upon graduation with the bachelor of science degree in Architectural Engineering are:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Areas of Knowledge

The areas of knowledge that define these objectives include both technical and non-technical areas.

Technical areas are:

- Elementary: The fundamentals for architectural engineering, including basic science and mathematics, building design and construction processes; overview of building systems; elementary principles and

processes of architecture; and laboratory measurement and data analysis.

- Intermediate: Introduction to building systems and their components, with corresponding analysis of electrical, HVAC, and lighting systems; as well as structural elements and components.
- Proficiency: Design, integration, and advanced analysis of electrical, HVAC, lighting, and structural systems; as well as the standards, codes and recommended practices that govern these building systems.
- Specialization: Advanced design, coupled with industry experience via internships, for building lighting and electrical system design, building HVAC systems design, building structural system design, and construction engineering and management.

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 Fall 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.