



Civil, Environmental, &
Architectural Engineering

UNIVERSITY OF COLORADO **BOULDER**

Undergraduate Advising Guide for Architectural Engineering



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Introduction

The purpose of this guide is to assist undergraduate students majoring in Architectural Engineering (AREN) to fulfill the AREN curriculum requirements for the Bachelor of Science (BS) degree. These requirements are structured to comply with College rules and to maintain our accreditation, in compliance with the rules of the Engineering Accreditation Commission of ABET (www.abet.org).

To respond to the rapid changes in technology and needs of the profession, our curriculum is dynamic, and consequently undergoes both major and minor revisions annually. As an undergraduate student, you will generally be expected to follow the curriculum in effect when you entered as a freshman. You should keep a copy of the university catalog and all written information including the version of the Advising Guide that was in effect when you entered the program. Copies of the curriculum, a course checklist, and a graphical flow chart are contained in this document. Alternatively, you may elect to follow a future revision to the curriculum in its entirety. If you decide to follow new curriculum guidelines, you must inform the Department.

The student is responsible for adherence to the AREN curriculum rules and requirements and should be aware that deviation from the planned sequence of courses may result in delayed graduation.

Mission Statement

The mission of the Department of Civil, Environmental, and Architectural Engineering is the education of undergraduate students to become leaders in the professional practice of engineering, contributing to technological advances that benefit humankind while enhancing the earth's physical and biological resources.

Program Educational Objectives

The educational objective of the Architectural Engineering program is to develop graduates who acquire the broad knowledge and skills necessary to successfully begin and sustain a career, and to become leaders who advance the state-of-the-art, in one of four core disciplines of the building industry:

- electrical and lighting systems
- heating, ventilating, and air conditioning (HVAC) systems
- structural systems
- construction engineering and management

The areas of knowledge required to achieve these objectives include both technical and non-technical areas. Technical areas include an elementary understanding of the fundamentals of architectural engineering, proficiency in the engineering sciences of buildings and their systems, proficiency in architectural engineering design and its integration across disciplines, and specialization in one of the four core areas of AREN practice. Non-technical areas include professional management and ethics, processes for communication, and broad exposure to the humanities and social sciences, especially architectural history.

These areas of knowledge must be complemented by skills in design, communication, and professional practice necessary to develop and sustain a career in the building industry. Design skills include problem definition, design workflow and processes, application of codes and standards, and design experience.

Communication skills include oral and written communication in the form of presentations, drawings, and report. Professional skills include resource allocation, planning, and teamwork.

While the educational objectives do not specifically address the development of graduates who pursue further graduate studies, it is recognized that advancing the state-of-the-art in the disciplines of the building industry may require additional education. To that end, the AREN program education objectives include graduate school in engineering and disciplines relevant to the building industry.

Student Outcomes

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

1. the ability to apply knowledge of mathematics, science, and engineering
2. the ability to design and conduct experiments
3. the ability to analyze and interpret data
4. the ability to design a system or component to meet desired needs
5. the ability to function on multidisciplinary teams
6. the ability to identify, formulate, and solve engineering problems
7. an understanding of professional and ethical responsibilities
8. the ability to communicate effectively through writing and/or drawing
9. the ability to communicate effectively through oral presentations
10. an understanding of the impact of engineering on society
11. an understanding of the necessity to engage in life-long learning
12. a knowledge of contemporary issues in civil, environmental, and architectural engineering
13. the ability to use modern engineering techniques, skills, and tools

Accreditation and Assessment

The AREN program is accredited by the Engineering Accreditation Commission of ABET. Accreditation involves a process of continuous improvement using a series of assessment tools that measure how well the program is achieving its stated outcomes and objectives. As a student, you can expect to take part in the following evaluations during (and after) your academic career at CU:

- **Faculty Course Questionnaire (FCQ)** – You will evaluate and provide feedback in every course you take at CU at the end of every semester.
- **Fundamentals of Engineering (FE) Exam** – This national exam is the first step toward professional registration as an engineer and all AREN students are required to take the exam prior to graduation. Most students take it in their last semester at CU.
- **Senior Exit Survey** – In your last semester, you will be asked to fill out a survey administered by the College that asks how well the outcomes listed above were met, and your overall satisfaction with the program, department, faculty, etc.
- **Alumni Survey** – We will send you a survey five years after graduation to evaluate if we met the program educational objectives.

Advising

The faculty and staff are here because they have a true commitment to education and want to see students succeed. However, you the student are ultimately responsible for ensuring that all graduation requirements have been satisfied, and for seeking out the advice and help you need. To assist in this, students have access to both faculty and staff advisors. The AREN Undergraduate Academic Advisor can also assist you with many questions about the curriculum.

- A) It is the individual student's responsibility to secure the approval of her/his advisor for the course of study for each semester. First- and second-year students meet with the AREN Undergraduate Academic Advisor, while third-year students and above meet with their faculty advisors. This activity occurs during the individual advising period, of which notification will be sent by email each semester. After the advising session, the advisor will sign the pink card in your file that will authorize the CEAE staff to remove the registration HOLD that prevents you from registering. IT IS NOT POSSIBLE TO REGISTER BEFORE THIS HOLD IS REMOVED.
- B) Graduation requirements are met through one of four distinct concentrations within the AREN curriculum – electrical/lighting, mechanical (HVAC), structural, or construction. Each concentration has a specific set of required upper-division courses and recommended technical electives. During the third year, each student must select one of the concentration tracks and choose a faculty advisor in their area of concentration. With this alignment of interests, the faculty advisor will best be able to help you identify appropriate technical electives; discuss career options; and suggest opportunities for internships, research, and employment.
- C) A listing of CEAE faculty and staff with contact information can be found at <http://ceae.colorado.edu/faculty-staff/>.
- D) Block diagrams for the program are included in this guide. Each student is responsible for tracking his/her progress on the block diagram and making sure that his/her online degree audit is up-to-date. Contact the AREN Undergraduate Academic Advisor to address any discrepancies in your audit.
- E) Occasional changes to course numbers, prerequisites, etc. may occur after this guide has been published. The most updated block diagram is always available from the Undergraduate Academic Advisor or at <http://ceae.colorado.edu/current-students/undergraduate/>.
- F) Not all courses are offered every semester. Those that are only offered once per year are marked on the block diagrams.
- G) The minimum course load for full time enrollment is 12 credit hours. The maximum course load is 19 credit hours. Variation must be requested by petition to the college.
- H) If problems arise with advising, the following steps are suggested:
 - i. See the AREN Undergraduate Academic Advisor.
 - ii. See the Associate Chair for Undergraduate Education.
 - iii. Contact the Assistant Dean for Students (ECAD 100) for questions concerning College or University rules or policies.

For more information on the civil, environmental, and architectural engineering program, visit our website at <http://ceae.colorado.edu>.

Math Placement

Incoming freshmen are placed into their first math course based on their score on the ALEKS math assessment. Students who do not start in Calculus 1 their first semester will not be able to follow the standard AREN block diagram on page 13 of this guide, as they will not have the prerequisites to take all courses in the semesters shown. These students are encouraged to complete APPM 1360 Calculus 2 for Engineers during the summer session after their freshman year in order to get back on the standard block diagram.

Students who cannot take APPM 1360 during the summer session should follow the Modified AREN Block Diagram on page 15 of this guide. While students following this modified plan may still be able to graduate in four years, please note that the four-year guarantee does not apply. The Department will make every effort to avoid course conflicts for students following the modified block diagram, but cannot guarantee that students will never encounter conflicts.

Transfer Procedures

The University and College have established procedures for admission of transfer students and evaluation of transfer credits. These policies are described on the undergraduate admissions website: <http://admissions.colorado.edu/undergraduate/apply/transfer>. However, once a student is admitted and transfer credits have been evaluated by the University, the CEAE Department is responsible for the final evaluation of the application of transfer credits to degree requirements. A student is required to obtain the approval of the CEAE Transfer Credit Evaluator for all transfer credits. Prof. Dobroslav Znidarcic (dobroslav.znidarcic@colorado.edu) is the current (Fall 2014) CEAE Transfer Credit Evaluator. The following recommendations are offered:

- A) It is the student's responsibility to ensure that transfer credits have been evaluated and approved by the Department.
- B) Newly admitted transfer students should make an appointment with the CEAE Transfer Credit Evaluator as soon as possible to obtain final approval of transfer credits. A transfer credit approval form, signed by the Transfer Credit Evaluator, will be placed in the student's file and will be required for graduation. The form will also be used by advisors to inform academic guidance.
- C) If there are questions or concerns about a transfer course, the Evaluator may request catalog pages or course descriptions, or may seek the advice of other faculty members. In some cases, it may be recommended that the student prepare a petition for transfer credit, with multiple levels of approval, to ensure that there will be no future questions. While the petition process may seem onerous, it is only used to protect the student's interest.
- D) Transfer credit issues can also arise for current students who take one or more courses at other institutions during their academic career, e.g., study abroad programs or summer school at a local college. Current students who are planning to take courses at another institution should seek preliminary approval of the transfer credits before taking the courses.

Additional Advising Resources

There are many advising resources available at CU-Boulder, but students frequently do not know they exist or hesitate to take advantage of them:

College of Engineering Advising Guides

The College publishes a comprehensive set of advising guides to provide students with timely and accurate information. These guides are not intended as a substitute for personal interaction between student and advisor, but can be a great way to get answers to many common questions and concerns. Brief summaries of the curricula and requirements for individual majors in the College can be found at www.colorado.edu/engineering/academics along with the following advising guides:

- Guide to Degrees, Minors & Certificates
- Personalize Your Academic Experience
- Academic Support
- Advising & Registration
- College Policies & Requirements
- Career Services
- Summer Session
- Student Organizations
- Internships, Research & Service Learning
- Graduation Ceremonies
- Undergraduate FAQs

The following College and University policies can also be found on the College website at www.colorado.edu/engineering/academics/policies:

- Academic Honesty
- Academic Policies
- Academic Probation and Suspension
- Classroom and Course-Related Behavior
- Confirming Your Major
- Four-Year Graduation Guarantee
- Grading Policies/Grade Appeal Policy
- Graduation Requirements
- Humanities, Social Sciences and Writing
- Student Conduct Code Policy
- Student Honor Code Policy

Career Counseling

Career Services can help students and alumni clarify career interests, values and work-related skills; explore potential careers and employers; and refine job seeking, interviewing, and resume preparation skills. They host Career Fairs and Internship Fairs, sponsor resume writing workshops, and hold mock interview sessions. Career Services is located in the Center for Community (C4C) Room N352, (303) 492-6541, or you may visit their website: <http://careerservices.colorado.edu>.

Counseling and Psychological Services

This multicultural center provides a variety of programs and assistance to address general academic or personal issues. They are located in C4C (Center for Community), 303-492-6766, or visit their website: <http://counseling.colorado.edu>.

Graduation Requirements

Failure to complete the requirements listed below will postpone graduation. Any exceptions will require authorization from the CEAE Operations Committee and the Assistant Dean for Students. Students should meet with the AREN Undergraduate Academic Advisor at least one semester prior to their planned graduation to review their records. It is the student's responsibility to be certain that all degree requirements have been met, to apply for graduation online, and to keep the AREN Undergraduate Academic Advisor and the Dean's Office informed of any change in graduation plans.

To be eligible for the AREN BS degree, students must meet the following minimum requirements:

1. The satisfactory completion of the prescribed and elective work in the AREN BS curriculum. A student must complete a minimum number of **128** semester hours, of which **the last 45 shall be earned after admission to the College of Engineering and Applied Science as a degree student.**
2. A minimum cumulative grade point average of 2.25 for all courses attempted and for all courses that count toward graduation requirements, excluding P grades for courses taken Pass/Fail. (Pass/Fail courses do not count for graduation credit.)
3. A minimum cumulative grade point average of 2.25 for all CEAE course work. This "major" grade point average is computed separately from the student's cumulative grade point average and includes only AREN and CVEN courses.
4. Successful completion of all Minimum Academic Preparation Standards (MAPS) requirements of the College.
5. Successful completion of WRTG 3030, *Writing on Science and Society* or an approved alternate writing course (HUEN 1010, HUEN 3100, WRTG 3035, or PHYS 3050). Any other exceptions to the WRTG 3030 requirement must be approved via petition by the Assistant Dean for Students.
6. Completion of the Fundamentals of Engineering (FE) Examination during the student's senior year. Graduation is not contingent upon passing. However, it is beneficial for your career to do so because this exam is the first step toward professional registration.
7. Submission of a completed Application for Diploma, online.
8. Obtain the recommendation of the CEAE faculty.
9. Obtain the recommendation of the faculty of the College of Engineering and Applied Science.

Note: Double degree students must obtain approval of both designated departments and colleges. The University normally requires that a minimum of an additional 30 semester credit hours be earned for the second degree outside of engineering or 15 credits for a second degree within engineering. However, BOTH degree requirements must be completed. Minor students must provide the Undergraduate Academic Advisor with a Minor Completion form to verify minor requirements have been completed.

BECAUSE THE **BURDEN OF PROOF** IS ON THE STUDENT, CONSULT THE ASSOCIATE CHAIR FOR UNDERGRADUATE PROGRAMS, YOUR FACULTY ADVISOR, OR THE UNDERGRADUATE COORDINATOR, AND PETITION FOR APPROVAL OF **ANY** PROGRAM DEVIATIONS.

Grades and Prerequisites/Co-requisites

The minimum passing grade for prerequisite and co-requisite courses is C-. The minimum passing grade for all other courses is D-.

Pass/fail courses do not count toward graduation. Students must petition to take a course pass/fail or for no credit.

All prerequisite/co-requisite waivers, including those for required courses taken in other departments, must be petitioned and approved by the course instructor, the CEAE Department, and the Assistant Dean for Students.

AREN Technical Elective Requirements

A technical elective is generally a course in engineering or science with technical content, selected in consultation with a faculty advisor at the upper (3000+) level. Courses listed as Concentrations in this guide are examples of technical electives. Up to 3 credit hours of Independent Study, Undergraduate Research, or the following ROTC courses are acceptable as technical elective credit: AIRR 3010 or NAVR 4010. A maximum of 6 credit hours of technical electives other than CVEN or AREN courses may be selected with the consent of the student's faculty advisor.

A list of potential technical electives for CEAE students can be found at <http://ceae.colorado.edu/wordpress/wp-content/uploads/CEAE-tech-elective-list.pdf>.

AREN Free Elective Requirements

A free elective is generally any college-level course. Free electives cannot be remedial courses needed to fulfill deficiencies (algebra, trigonometry, precalculus, introductory chemistry/physics, etc. may not be used), and cannot be similar to courses used toward graduation requirements (non-calculus-based physics, etc. may not be used).

AREN Basic Engineering Elective Requirements

Students who do not take GEEN 1400 may substitute any 3-credit technical course given in the engineering college with a designator ASEN, AREN, APPM, CHEN, COEN, CVEN, CSCI, ECEN, EVEN, GEEN, or MCEN. Remedial courses or courses approved as HSS electives may not be used.

Humanities and Social Science (HSS) Elective Requirements

All engineering students must complete the minimum HSS requirements listed at www.colorado.edu/engineering/academics/policies/HSS. ENVD 3114 and ENVD 3134 are required courses that fulfill the 6 credit hours of upper-division HSS electives. The remaining 9 credit hours of HSS electives may be fulfilled with either upper- or lower-division courses from the approved list.

Engineering Science Track

For those students who have advanced placement credits, seek additional career opportunities in research and development in engineering and technology, or better preparation for advanced degrees in engineering, they should consider the Engineering Science Track which aims to provide a higher-level preparation in analytical and computer modeling essential in modern engineering and technology. Interested students should contact Prof. Ronald Pak (pak@colorado.edu) or visit the CEAE website.

Additional Educational Opportunities

Independent Study and Undergraduate Research

Undergraduates can participate in ongoing research through independent study projects, the Undergraduate Research Opportunities Program (UROP), and as research assistants for sponsored projects. These opportunities promote individual contact with faculty and graduate students, and they provide an educational experience that cannot be obtained in the normal classroom setting.

Up to three (3) semester credit hours of Independent Study are acceptable for Technical Electives.

An Independent Study is normally supervised by a CEAE faculty member. An approved Independent Study supervised by a faculty member outside of CEAE may also be applied to curriculum requirements as an out-of-department technical elective.

To pursue an independent study, an Independent Study Agreement Form must be completed and signed by both the student and the sponsor of the Independent Study or Undergraduate Research (which includes a written Statement of Work). These forms are available through the College of Engineering Advising Guide <http://engineering.colorado.edu/students/advising.htm> or the CEAE Undergraduate Coordinator.

Concurrent BS/MS Program

AREN students who plan to continue their education to obtain a graduate degree after completing the requirements for their BS will usually find it advantageous to apply for admission to the concurrent BS/MS degree program. This program allows students who qualify (a 3.25 cumulative GPA is required) to plan a graduate program from the beginning of their junior year rather than from their first year of graduate study. Up to six credit hours of appropriate 5000-level technical elective courses may be applied to the MS degree, subject to GPA restriction. Interested students should discuss this option with their faculty advisor and obtain additional information from the AREN Undergraduate Academic Advisor or CEAE Graduate Coordinator.

The tuition rate for students in this program will be at the undergraduate rate unless the student converts to graduate status after completing the BS requirements.

Undergraduate Research Experience

The Department of Civil, Environmental, and Architectural Engineering of the University of Colorado Boulder is a major research center in the U.S. Most of the CEAE faculty members are active researchers in their field, leading interesting and challenging research projects supported by the government and industry. Students are encouraged to take advantage of such an inquisitive setting to enhance their educational experience by exploring early their ability in guided or independent research.

Undergraduate research assistantships are available during the academic year and the summer semester from individual faculty, the College of Engineering, as well as campus's UROP program. Those in the Engineering Science Track are particularly encouraged to participate in such undergraduate research activities.

Discovery Learning Apprenticeships

As a way to encourage undergraduate students to experience research, the College invites applications annually for a number of a Discovery Learning Apprenticeships. Students can earn an hourly wage while engaging in research with college faculty and graduate students. Positions are announced in April for the following fall term and spring term. Students must apply and selection for positions is competitive. For more information, an application and a list of current discovery learning projects, visit <http://engineering.colorado.edu/activelearning/discovery.htm>.

Double Degrees

It is possible to obtain double degrees in two engineering disciplines or one degree in engineering and a second degree from a department in another college or school of the University. Students must satisfy curricula for both programs and normally complete a minimum of 30 additional semester credit hours above and beyond the degree with the larger minimum credit hour requirement. If the student can satisfy both degree requirements with fewer than 30 additional hours, the difference can be made up with free electives. If both bachelor's degrees are in the College of Engineering and Applied Science, a minimum of 143 credits are required (128 + 15).

Of the 30 additional semester credit hours, regular double degree students must complete 24 semester credit hours in courses offered by the secondary academic department or in courses approved in advance by the department as substitutes. Transfer students pursuing double degrees must complete a minimum of 75 semester credit hours as a degree student in the College of Engineering and Applied Science and must satisfy all other stipulations regarding total hours required and approval of all coursework by both departments concerned.

Students may coordinate their double degree schedule by closely interacting with academic advisors in each of the departments involved. It is in the student's best interest to select courses that satisfy degree requirements in both departments as frequently as possible. In some cases, it may be preferable to pursue an MS degree rather than two undergraduate degrees.

Minors

Numerous minor opportunities exist that would satisfy humanities/social science electives, technical electives, and/or free electives. Many require no additional course work beyond the minimum BS requirements. For more information on minor opportunities and requirements, visit: <http://advising.colorado.edu/students/current-students/majors-and-minors-available-to-as-students> and <http://www.colorado.edu/engineering/academics/degrees-minors-certificates>.

Semester at Sea

Administered through the Office of International Education, and managed by the University of Pittsburgh's Institute for Shipboard Education, students explore and learn valuable insights into the various societies visited, allowing students to analyze and discuss their observations in formal classes on the shipboard campus. Set sail aboard the SS Universe Explorer each semester and summers. Contact the Office of International Education for more information, Center for Community (C4C) Suite S355, (303) 492-7741.

Study Abroad

Study abroad, usually taken in the junior year, can be an enriching experience. Information about this unique opportunity can be obtained from the University Study Abroad Office, Center for Community (C4C) Suite S355, (303) 492-7741. The purpose of these guidelines is to assist the student and his or her faculty advisor in planning the courses to take overseas. Many liberal arts courses taken abroad will satisfy the requirements for electives in the humanities and social sciences. Some courses taken abroad may count as technical electives. To guarantee that the courses taken abroad will count toward the AREN degree, the planned program must be approved by your faculty advisor and the Transfer Credit Evaluator.

Student Societies

Students have excellent opportunities to become involved in discipline-related activities outside of the classroom. The Department has active chapters in a number of major student societies including American Society of Civil Engineers (ASCE), American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), Associated General Contractors (AGC), Illumination Engineering Society (IES), and Engineers without Borders (EWB-CU).

CEAE Policy on Academic Integrity

The Department of Civil, Environmental, and Architectural Engineering (CEAE) requires all students to adhere to a strict policy of academic integrity. These expectations are in accordance with the University of Colorado Boulder Honor Code (<http://www.colorado.edu/honorcode/>), but this policy is intended to provide more specific guidelines for all undergraduate and graduate students in CEAE. Ethical behavior in college sets the stage for a lifetime of professional and ethical behavior that is expected of all engineering professionals. This policy describes the academic sanctions that will be imposed by CEAE faculty members. Faculty retain the right to set academic sanctions, and if they choose individual courses can deviate from the expectations stated below; these changes will be noted in the course syllabus. All incidents of academic misconduct will be reported to the Honor Code Council. Non-academic sanctions are the purview of the Honor Code Council.

Any activity that could give you an unfair advantage over other students may be cheating. Specific examples of actions that are considered to be cheating and therefore violations of academic integrity:

- Plagiarizing a homework, lab report, or problem set. On assignments that require you to use supplemental materials, you must properly document the sources of information that you used. If you are uncertain about allowable reference materials or how to document your sources, ask your instructor in advance. Specific examples of plagiarism include:
 - copying from a solution manual
 - copying from Internet sites
 - copying from previous semester's homework set or lab report
 - copying directly from classmates
 - copying lab data that you yourself did not participate in collecting
- Plagiarizing content in a paper, report, thesis, or dissertation, by copying material from a published sources or the internet, without appropriate citation format and attribution
- Using unapproved information during a closed-book test or quiz (such as a reference sheet, information stored in a calculator, iPhone, information written on your skin)
- Copying from another student during a quiz, exam, or test
- Working in groups on web based quizzes, exams, or tests
- Working in groups on take-home quizzes, exams, or tests
- Asking another student about questions on an exam that you have not yet taken
- Changing the answer on your test/homework after it was graded and then telling the instructor that there was a grading mistake
- Allowing another student to copy your homework, lab report, or allowing another student to look at your answers during a quiz or exam
- The list above is not exhaustive; other violations are possible

Any violation will be reported to the Honor Code Council.

Any first violation of academic integrity on graded course activities (i.e. homework, lab reports, exams) will result in a minimum sanction of a zero score and an entry in your department file. Instructors can increase these penalties to assigning a failing grade (F) for the entire course. The department will retain a list of all instances of academic integrity violations. Additional sanctions will be imposed for subsequent violations.

AREN Block Diagram

Sem	CR						
8 SPR	17	<u>Tech Elective-3</u>	<u>Tech Elective-3</u>		AREN 4317-5 # AREN Design (ARCH 4010*)	ENVD 3134-3 # History and Theory of ENVD: Precincts	<u>HSS Elective-3</u>
7 FALL	17	<u>Concentration II</u> AREN/CVEN XXXX-3	<u>Tech Elective-3</u>		ARCH 4010-5 # Arch. Design (Senior standing)	ENVD 3114-3 # History and Theory of ENVD: Buildings	<u>HSS Elective-3</u>
6 SPR	15	<u>Concentration I</u> AREN/CVEN XXXX-3	<u>Tech Elective-3</u>	<u>Proficiency I</u> CVEN 4545/4555-3 *** Struct. Design AREN 4110-3 # HVAC Design AREN 4570-3 # Electrical Systems CVEN 3256-3 Const. Equip./Methods		<u>Proficiency II</u> CVEN 4545/4555-3 *** AREN 4110-3 # AREN 4570-3 # CVEN 3256-3	<u>College-Appr. Writing Course-3**</u>
5 FALL	15		AREN 3540-3 # Illumination 1 (COEN 1300, APPM 2350)	AREN 3010-3 # Mech. Systems (AREN 2050, 2110, 2120)	ECEN 3030-3 # Electrical Circuits (APPM 2360)	CVEN 3525-3 Structural Analysis (CVEN 3161)	<u>Free Elective-3</u>
4 SPR	16	APPM 2360-4 Introduction to Linear Algebra & Differential Equations (APPM 1360)	COEN 1300-3 Engrg. Computing (co-req. APPM 1350)	AREN 2120-3 # Fluid Mech. & Heat Transfer (APPM 2350, AREN 2110, co- req. APPM 2360)	CVEN 3246-3 Introduction to Construction (4 th -semester standing)	CVEN 3161-3 Mechanics of Materials I (CVEN 2121, co- req. APPM 2360)	
3 FALL	17	APPM 2350-4 Calculus III for Engineers (APPM 1360)	PHYS 1120-4 Gen. Physics II (PHYS 1110, co- req. APPM 1360)	AREN 2110-3 Thermodynamics (PHYS 1110, co- req. APPM 1360)	AREN 2050-3 # Building Materials and Systems (Soph. standing)	CVEN 2121-3 Analytical Mechanics I (PHYS 1110, co- req. APPM 2350)	
2 SPR	17	APPM 1360-4 Calculus II for Engineers (APPM 1350)	PHYS 1110-4 Gen. Physics I (co-req. APPM 1350)		CVEN 2012-3 # Introduction to Geomatics (APPM 1350)	GEEN 1400-3 Engrg. Projects <u>OR</u> Basic Engineering Elective	<u>HSS Elective-3**</u>
1 FALL	14	APPM 1350-4 Calculus I for Engineers (APPM 1235 or ALEKS score 76+)	CHEN 1211-4 Gen. Chem. for Engineers**** (1 yr. HS chem. or CHEM 1021, HS algebra)	CHEM 1221-1 General Chemistry Lab for Engineers	AREN 1316-2 # Introduction to Architectural Engineering	AREN 1027-3 Engineering Drawing <u>OR</u> AREN 1037-3	

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Course is offered only once per year (FALL or SPRING as shown).

() Prerequisite and co-requisite requirements for course listed.

* Other prerequisites: AREN 3010, AREN 3540, CVEN 3246, CVEN 3525.

** College-approved writing courses: HUEN 1010 (taken in first two semesters of college only); or HUEN 3100, WRTG 3030, WRTG 3035, or PHYS 3050 (junior standing).

*** CVEN 4545 Steel Design offered spring semester only; CVEN 4555 Reinforced Concrete Design offered fall semester only.

**** CHEN 1211 and CHEM 1221 must be taken concurrently.

Modified AREN Block Diagram with Precalculus

Sem	CR						
8 SPR	17	Proficiency/ Concentration/ Tech Elective-3 ⁺	Proficiency/ Concentration/ Tech Elective-3 ⁺	Proficiency/ Concentration/ Tech Elective-3 ⁺	AREN 4317-5 # AREN Design (ARCH 4010*)	Proficiency/ Concentration/ Tech Elective-3 ⁺	
7 FALL	17	Proficiency/ Concentration/ Tech Elective-3 ⁺	Proficiency/ Concentration/ Tech Elective-3 ⁺	AREN 3010-3 # Mech. Systems Bldgs. (AREN 2050, 2110, 2120)	ARCH 4010-5 # Arch. Design (Senior standing)	ECEN 3030-3 # Electrical Circuits (APPM 2360)	
6 SPR	18	Proficiency/ Concentration/ Tech Elective-3 ⁺	Proficiency/ Concentration/ Tech Elective-3 ⁺	AREN 2120-3 # Fluid Mech. & Heat Transfer (APPM 2350, AREN 2110, co- req. APPM 2360)	ENVD 3134-3 # History and Theory of ENVD: Precincts	CVEN 3525-3 Structural Analysis (CVEN 3161)	<u>College-Appr. Writing Course-3**</u>
5 FALL	16	APPM 2360-4 Introduction to Linear Algebra & Diff. Equations (APPM 1360)	AREN 3540-3 # Illumination 1 (GEEN 1300, APPM 2350)		ENVD 3114-3 # History and Theory of ENVD: Buildings	CVEN 3161-3 Mechanics of Materials I (CVEN 2121, co- req. APPM 2360)	<u>HSS Elective-3</u>
4 SPR	16	APPM 2350-4 Calculus III for Engineers (APPM 1360)	COEN 1300-3 Engrg. Computing (co-req. APPM 1350)		CVEN 3246-3 Introduction to Construction (4 th -semester standing)	CVEN 2121-3 Analytical Mechanics I (PHYS 1110, co- req. APPM 2350)	<u>HSS Elective-3</u>
3 FALL	17	APPM 1360-4 Calculus II for Engineers (APPM 1350)	PHYS 1120-4 Gen. Physics II (PHYS 1110, co- req. APPM 1360)	AREN 2110-3 Thermodynamics (PHYS 1110, co- req. APPM 1360)	AREN 2050-3 # Building Materials and Systems (Soph. standing)		<u>Free Elective-3</u>
2 SPR	16 or 17	APPM 1350-4 Calculus I for Engineers (APPM 1235)	PHYS 1110-4 Gen. Physics I (co-req. APPM 1350)		CVEN 2012-3 # Introduction to Geomatics (APPM 1350)	GEEN 1400-3 Engrg. Projects <u>OR</u> Basic Engineering Elective	<u>HSS Elective-3**</u>
1 FALL	13 or 14	APPM 1235-4 Pre-Calculus for Engineers (ALEKS score 61+)	CHEN 1211-4 Gen. Chem. for Engineers*** (1 yr. HS chem. or CHEM 1021, HS algebra)	CHEM 1221-1 General Chemistry Lab for Engineers***	AREN 1316-2 # Introduction to Architectural Engineering	AREN 1027-3 Engineering Drawing <u>OR</u> AREN 1037-3	

Fall 2014/ revised August 2014

Course is offered only once per year (FALL or SPRING as shown).

() Prerequisite and co-requisite requirements for course listed.

* Other prerequisites: AREN 3010, AREN 3540, CVEN 3246, CVEN 3525.

** College-approved writing courses: HUEN 1010 (taken in first two semesters of college only); or HUEN 3100, WRTG 3030, WRTG 3035, or PHYS 3050 (junior standing).

*** CHEN 1211 and CHEM 1221 must be taken concurrently.

+ Semesters in which proficiencies/concentrations/tech electives are taken will vary by concentration. A complete block diagram for each concentration is available from the AREN undergraduate advisor.

AREN Block Diagram – Engineering Science Track

Sem	CR						
8 SPR	17	<u>Tech Elective-3</u>	APPM 4120-3 Ops. Research <u>OR</u> CVEN 4537-3 Num. Methods		AREN 4317-5 # AREN Design (ARCH 4010*)	ENVD 3134-3 # History and Theory of ENVD: Precincts	<u>HSS Elective-3</u>
7 FALL	17	<u>Concentration II</u> AREN/CVEN XXXX-3	APPM 4350-3 Methods in Applied Math <u>OR</u> equivalent		ARCH 4010-5 # Arch. Design (Senior standing)	ENVD 3114-3 # History and Theory of ENVD: Buildings	<u>HSS Elective-3</u>
6 SPR	15	<u>Concentration I</u> AREN/CVEN XXXX-3	<u>Tech Elective-3</u>	<u>Proficiency I</u> CVEN 4545/4555-3 *** Struct. Design AREN 4110-3 # HVAC Design AREN 4570-3 # Electrical Systems CVEN 3256-3 Const. Equip./Methods		<u>Proficiency II</u> CVEN 4545/4555-3 *** AREN 4110-3 # AREN 4570-3 # CVEN 3256-3	<u>College-Appr. Writing Course-3**</u>
5 FALL	15		AREN 3540-3 # Illumination 1 (COEN 1300, APPM 2350)	AREN 3010-3 # Mech. Systems (AREN 2050, 2110, 2120)	ECEN 3030-3 # Electrical Circuits (APPM 2360)	CVEN 3525-3 Structural Analysis (CVEN 3161)	<u>Free Elective-3</u>
4 SPR	16	APPM 2360-4 Introduction to Linear Algebra & Differential Equations (APPM 1360)	COEN 1300-3 Engrg. Computing (co-req. APPM 1350)	AREN 2120-3 # Fluid Mech. & Heat Transfer (APPM 2350, AREN 2110, co- req. APPM 2360)	CVEN 3246-3 Introduction to Construction (4 th -semester standing)	CVEN 3161-3 Mechanics of Materials I (CVEN 2121, co- req. APPM 2360)	
3 FALL	17	APPM 2350-4 Calculus III for Engineers (APPM 1360)	PHYS 1120-4 Gen. Physics II (PHYS 1110, co- req. APPM 1360)	AREN 2110-3 Thermodynamics (PHYS 1110, co- req. APPM 1360)	AREN 2050-3 # Building Materials and Systems (Soph. standing)	CVEN 2121-3 Analytical Mechanics I (PHYS 1110, co- req. APPM 2350)	
2 SPR	17	APPM 1360-4 Calculus II for Engineers (APPM 1350)	PHYS 1110-4 Gen. Physics I (co-req. APPM 1350)		CVEN 2012-3 # Introduction to Geomatics (APPM 1350)	GEEN 1400-3 Engrg. Projects <u>OR</u> Basic Engineering Elective	<u>HSS Elective-3**</u>
1 FALL	14	APPM 1350-4 Calculus I for Engineers (APPM 1235 or ALEKS score 76+)	CHEN 1211-4 Gen. Chem. for Engineers**** (1 yr. HS chem. or CHEM 1021, HS algebra)	CHEM 1221-1 General Chemistry Lab for Engineers	AREN 1316-2 # Introduction to Architectural Engineering	AREN 1027-3 Engineering Drawing <u>OR</u> AREN 1037-3	

Fall 2014/revised May 2014

Course is offered only once per year (FALL or SPRING as shown).

() Prerequisite and co-requisite requirements for course listed.

* Other prerequisites: AREN 3010, AREN 3540, CVEN 3246, CVEN 3525.

** College-approved writing courses: HUEN 1010 (taken in first two semesters of college only); or HUEN 3100, WRTG 3030, WRTG 3035, or PHYS 3050 (junior standing).

*** CVEN 4545 Steel Design offered spring semester only; CVEN 4555 Reinforced Concrete Design offered fall semester only.

**** CHEN 1211 and CHEM 1221 must be taken concurrently.

ARCHITECTURAL ENGINEERING CONCENTRATIONS

Fundamental – All students take the fundamental courses in all **four** concentration areas.

Proficiency – Students choose **two** of the four areas in which to take a second proficiency-level course.

Concentration – Students choose **one** area in which to take two additional concentration-level courses.

Note: Concentrations do not appear on transcripts or diplomas.

STRUCTURAL SYSTEMS

- Fundamental** – CVEN 3525 Structural Analysis (CVEN 3161) – **Fall and Spring**
Proficiency – CVEN 4545 Steel Design (CVEN 3525) – **Spring**
or CVEN 4555 Reinforced Concrete Design (CVEN 3525) – **Fall**
Concentration – CVEN 4161 Mechanics of Materials II (CVEN 3161) – **Spring**
and one of the following:
CVEN 4545 or 4555 (whichever not selected as proficiency)

MECHANICAL SYSTEMS

- Fundamental** – AREN 3010 Mechanical Systems for Buildings (AREN 2050, 2110, 2120) – **Fall**
Proficiency – AREN 4110 HVAC Design (AREN 3010) – **Spring**
Concentration – AREN 4830 Computer Simulation of Building Systems
AREN 4890 Sustainable Building Design (AREN 3010)

ELECTRICAL/LIGHTING SYSTEMS

- Fundamental** – ECEN 3030 Electrical Circuits (APPM 2360) – **Fall**
and AREN 3540 Illumination I (GEEN 1300, APPM 2350) – **Fall**
Proficiency – AREN 4570 Electrical Systems (ECEN 3030) – **Spring**
Concentration – AREN 4550 Illumination II (AREN 3540) – **Spring**
AREN 4560 Luminous Radiative Transfer (AREN 3540) – **Spring**

CONSTRUCTION ENGINEERING AND MANAGEMENT

- Fundamental** – CVEN 3246 Introduction to Construction (4th-semester standing) – **Fall and Spring**
Proficiency – CVEN 3256 Construction Equipment & Methods (CVEN 3246) – **Fall**
Concentration – AREN 4506 Project Management I (CVEN 3246) – **Fall and Spring**
AREN 4606 Project Management II (CVEN 3246, AREN 4506) - **Spring**

ELECTIVE REQUIREMENTS

Basic Engineering Elective – Students who do not take GEEN 1400 may substitute any 3-credit technical course given in the engineering college with a designator ASEN, AREN, APPM, CHEN, COEN, CVEN, CSCI, ECEN, EVEN, GEEN, or MCEN. Remedial courses (precalculus, etc.) or courses approved as HSS electives may not be used.

Free Elective – Any college-level course, except: cannot be remedial courses needed to fulfill deficiencies (algebra, trigonometry, precalculus, introductory chemistry, etc.) and cannot be similar to courses used toward graduation requirements (non-calculus-based physics, etc.).

Humanities and Social Science (HSS) Elective – See the College requirements at www.colorado.edu/engineering/academics/policies/HSS. A list of approved courses by subject is available on the CEAE website.

Technical Elective – Generally, an upper-division (3000+) science or engineering course with technical content. All upper-division AREN/CVEN courses are technical electives; up to 6 credits outside of AREN/CVEN may be selected with faculty advisor consent. Up to 3 credits of independent study, undergraduate research, or the following ROTC courses are acceptable as technical elective credit: AIRR 3010 or NAVR 4010. See the CEAE website for a list of potential technical electives for AREN students.