ARCHITECTURAL ENGINEERING

Architectural engineering focuses on the design, construction, and operation of buildings and the integration of their systems. The department offers Master of Science (MS) and Doctor of Philosophy (PhD) degrees in architectural engineering with a study emphasis in (1) building energy, (2) illumination, (3) materials and resources, and (4) construction engineering and management.

Graduate studies in architectural engineering are offered through the Department of Civil, Environmental, and Architectural Engineering (http://www.colorado.edu/ceae/prospective-students/graduate-studies). The Graduate Record Examination (GRE), consisting of the aptitude tests and advanced test in engineering, is used to evaluate MS and PhD candidates. Candidates who submit GRE scores are more likely considered for financial assistance.

Course code for this program is AREN.

Research Interests and Facilities

The Department has a wide variety of research facilities, including a 15g-ton centrifuge for geotechnical and structural model studies and a large 440g-ton geotechnical centrifuge for use in model testing. Also available is an instructional computing facility, the Bechtel Laboratory and the M.Y. Leung Computational Laboratory for Soils and Structures, both equipped with Windows and Linux high-performance workstations. In addition, extensive structural engineering, engineering mechanics and geotechnical capabilities exist such as a one-million-pound universal testing machine and several cubical cells for multi-axial testing of materials. A 40 ft. by 80 ft. structural strong floor with associated equipment permits the testing of a wide variety of structural configurations under controlled, both static and dynamic loading. The hydraulics and water resources research laboratories include excellent facilities in water quality and environmental engineering. A unique workstation laboratory for advanced decision support systems is available. Programs in construction management and building energy are well supported. The 3600 sq. ft. mechanical and energy laboratory is capable of testing full-scale, commercial building systems and their controls using a one-of-a-kind data acquisition and experimental control system. The laboratory has been recently redesigned and renovated for maximum flexibility to encourage a wide variety of research and testing procedures.

The Environmental Engineering program maintains approximately 12,000 sq. ft. of laboratories in the areas of process research, environmental microbiology, environmental chemistry, water quality, air quality, molecular biology, toxicology, and field ecology. The Environmental Sustainability cluster and the Center for Environmental Mass Spectrometry offer formal collaborations between the CU Boulder Environmental Engineering Group, the Mechanical Engineering air research group, the US Geological Survey, and industry partners, providing state-of-the-art facilities for research and teaching.

The Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) is an interdisciplinary center of excellence, housed within the Department of Civil, Environmental and Architectural Engineering. CADSWES focuses on applying advanced computing techniques to provide decision makers with decision support systems (DSSs) to help them more effectively manage water and environmental systems.

Current research covers such topics as water and wastewater treatment, surface and subsurface contaminant transport, decision support systems, hydraulic research, land treatment, rapid infiltration, and activated sludge processes. Cost prediction in construction, construction management, energy conservation in buildings, solar applications, and lighting systems are included. Advances in soil mechanics, rock mechanics, soil dynamics and geotechnical earthquake engineering, foundation engineering, computational geomechanics, centrifugal modeling, geosynthetics, and glacier flows have been produced. Research in structures includes stability, damage and fracture, material microstructures, durability, finite element modeling, reinforced concrete, earthquake responses, reinforced masonry structures, prestressed concrete, and dynamic control.

Master’s Degrees

- Architectural Engineering - Master of Science (MS) (catalog.colorado.edu/graduate/colleges-schools/engineering-applied-science/programs-study/architectural-engineering/architectural-engineering-master-science-ms)

Doctoral Degree

- Architectural Engineering - Doctor of Philosophy (PhD) (catalog.colorado.edu/graduate/colleges-schools/engineering-applied-science/programs-study/architectural-engineering/architectural-engineering-doctor-philosophy-phd)

Courses

AREN 5010 (3) HVAC System Modeling and Control
Engineering course devoted to building automation and control systems. Topics include HVAC control technology and strategies, measurement and device technologies, analysis and modeling of dynamic systems, simulation of conventional and advanced control approaches, assessment of control loop performance and hands-on direct digital control (DDC) programming exercises as used in current building control practice.
Equivalent - Duplicate Degree Credit Not Granted: AREN 4010
Recommended: Prerequisite AREN 4140.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5020 (3) Building Energy Audits
Analyzes and measures performance of HVAC systems, envelopes, lighting and hot water systems, and modifications to reduce energy use. Emphasizes existing buildings.
Requisites: Restricted to graduate students only.
Recommended: Prerequisite AREN 3010.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5050 (3) Advanced Solar Design
Predicts performance and analyzes economics of low-temperature, high-temperature, photovoltaic, and other innovative solar systems. Also includes performance prediction methods for solar processes.
Requisites: Restricted to graduate students only.
Recommended: Prerequisite AREN 2120.
Additional Information: Departmental Category: Building Systems Engineering
AREN 5070 (3) Thermal Analysis of Buildings
Examines response factors, conduction transfer functions and weighting factors for dynamic analysis of building envelopes. Also studies radiative and convective exchange in buildings, internal gains and infiltration analysis as modeled in hourly simulations.
Recommended: Prerequisite AREN 3010.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5080 (3) Computer Simulation of Building Energy Systems
Introduces major simulation programs for analysis of building energy loads and system performance. Focuses on one hourly simulation program to develop capability for analysis of multizone structure.
Requisites: Requires prerequisite course of AREN 4110 or AREN 5110 (minimum grade C). Restricted to graduate students only.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5110 (3) HVAC Design
Applies engineering principles to the design of heating, ventilating and air conditioning (HVAC) systems for buildings. Covers HVAC systems description, load estimation, psychometrics, coils and heat exchangers, air and water distribution systems and primary equipment and systems.
Equivalent - Duplicate Degree Credit Not Granted: AREN 4110
Recommended: Prerequisite AREN 3010.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5130 (3) Optical Design for Illumination and Solid State Lighting
Covers the optical design process for illumination-based optics, emphasis on applications in architectural lighting. In-depth coverage of luminaire photometry, lamps, materials, manufacturing methods, product performance requirements. Projects utilize optical design software and include a variety of lamp types including LEDs using both reflector/lens optics.
Equivalent - Duplicate Degree Credit Not Granted: AREN 4130
Recommended: Prerequisite AREN 3540.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5540 (3) Exterior Lighting Systems
Engages students in exploring and solving lighting problems for exterior environments. Provides an understanding of the design criteria and lighting equipment used in three primary exterior applications: parking lots and roadways, floodlighting of buildings, and sports facilities. Taught intermittently.
Equivalent - Duplicate Degree Credit Not Granted: AREN 4540
Recommended: Prerequisites AREN 3540 and AREN 4550.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5890 (3) Sustainable Building Design
Introduces green building design procedure/approach and provides insight into evolving design principles; explores aspects of building thermal/energy performance, indoor/outdoor environmental quality, occupant comfort and climate relevant to building design (structures not covered); emphasizes both comprehensive understanding and practical applications of sustainable building design strategies; applies prevailing simulation tools to assist green building design.
Equivalent - Duplicate Degree Credit Not Granted: AREN 4890
Requisites: Restricted to graduate students only.
Recommended: Prerequisite AREN 3010.
Additional Information: Departmental Category: Building Systems Engineering

AREN 5990 (3) Compu Fluid Dynamics (CFD) Analysis for Built/Natural Envrnnts
Explores the fundamentals of simulating/analyzing civil and architectural environments with Computational Fluid Dynamics (CFD) method. Run with two parallel sessions: fundamentals and applications, with fundamental lectures presenting the principles of CFD technologies, and application sessions demonstrating the application of CFD for resolving building and environmental engineering problems (different than MCEN/ASEN) with hands-on exercises.
Equivalent - Duplicate Degree Credit Not Granted: AREN 4990
Requisites: Restricted to graduate students only.
Recommended: Prerequisites AREN 2120 and APPM 2360.
Additional Information: Departmental Category: Building Systems Engineering

AREN 6940 (1) Master's Degree Candidate
Grading Basis: Pass/Fail
Additional Information: Departmental Category: Building Systems Engineering

AREN 6950 (1-6) Master's Thesis
Additional Information: Departmental Category: Building Systems Engineering

AREN 6960 (1-3) Master's Report
Repeatable: Repeatable for up to 3.00 total credit hours.
Additional Information: Departmental Category: Building Systems Engineering

AREN 8990 (1-10) Doctoral Thesis
A minimum of 30 credit hours is required.
Additional Information: Departmental Category: Building Systems Engineering