

Architectural Engineering *Career Guide*



THE UNIVERSITY OF TEXAS AT AUSTIN

Civil, Architectural and
Environmental Engineering

The undergraduate curriculum in Architectural Engineering in the Department of Civil, Architectural and Environmental Engineering at the University of Texas at Austin provides you, our students, with a strong foundation in the traditional areas of Architectural Engineering practice. The curriculum allows you to tailor your studies to one or more areas of practice: Building Energy and Environments, Construction Engineering and Project Management, Construction Materials, or Structural Engineering. At the same time, the breadth and depth of our program provide a solid background for non-traditional career paths, or the pursuit of research and graduate studies either within or outside civil and architectural engineering.

To help you better understand the choices you can make when designing your course of study, this document provides a description of each of the most commonly encountered areas of practice, together with examples of typical employers and career paths, and the courses that can better prepare you for each area. As a degree program in the Department of Civil, Architectural and Environmental Engineering, Architectural Engineering offers a broad spectrum of employment opportunities, in both the public and the private sectors, within the US and abroad. These opportunities exist in both technical and management positions within organizations of varying size that deal with a dizzying array of issues associated with both engineered and natural systems. Organizations that operate on a larger geographical scale frequently provide the opportunity for travel and have the expectation of occasional relocations as your career progresses. Some jobs afford the opportunity to work outside (such as construction-related positions), some (for example, design-

oriented) can allow you to qualify faster for a P.E. license than others, and some engineering specializations are centralized in large urban areas. Careers in engineering education and research are other possibilities for those who go on to earn a Ph.D. Given the variety and complexity of career choices, you should use this document only as a starting point for discussions with practicing engineers, faculty members, and career professionals (<http://ecac.engr.utexas.edu/>; <http://www.utexas.edu/student/careercenter/>) when considering your own career interests and the courses that will best serve those interests.

Your education at the University of Texas will provide an excellent foundation. To ensure a successful career you will need to further develop your technical and non-technical skills through a combination of practical experience and education. Because technology will continue to evolve, continuing education throughout your career is essential. Also, because many Architectural Engineering jobs involve a significant amount of interaction with other team members, clients, and the general public, good communication and interpersonal skills will always be critical to success. Later in your career, business skills can be very useful as you move into management (and possibly ownership) positions in engineering organizations. More so than with other engineering fields, Architectural Engineering has many entrepreneurial opportunities in businesses ranging from small consulting firms to the largest companies. Whatever career path you choose, this Department is committed to helping you succeed in meeting your goals.

Area of Practice

Building Energy

& Environments



Building Energy and Environments engineering involves the design of the systems that control the environment of the building, including thermal comfort, indoor air quality, illumination, and acoustics. Building Energy and Environment engineers specialize in the design of heating, ventilating, air-conditioning, refrigeration, plumbing, fire protection, lighting, and acoustics and noise-reduction systems. They use analytical and numerical techniques to predict behavior of building mechanical and electrical systems to minimize total energy consumption while providing an appropriate environment in the building. Given that Americans, on average, spend 95% of their time in buildings, and that buildings are responsible for 30-40% of total energy use, and building environmental systems represent 20 – 60% of the construction costs of a typical commercial building, architectural engineers with specialization in Building Energy and Environments have the opportunity to have an enormous impact in the construction and operation of buildings. Engineers who specialize in Building Energy and Environments are integral parts of building design, construction, and forensics teams. They closely work with architects, industrial hygienists, façade engineers, structural engineers, and other building professionals to provide optimal integration of environmental systems with other building systems.

Typical Engineering Positions

Design

- Design of heating, ventilating, air-conditioning, plumbing and electrical systems for commercial, residential, and industrial buildings.
- Moisture and pollutant concentration control in new and existing buildings and facilities.
- Green building professionals.

Analysis

- Analysis of environmental and structural (building envelope) systems that affect the energy consumption of buildings.
- Life-cycle cost analysis of different energy-saving measures in buildings.
- Comparison of ventilation alternatives to maximize occupant health and productivity and minimize energy use.

Field and/or Laboratory measurements

- Testing of different systems and methods for control of building environments.

Safety Inspection; Forensics; Investigation

- Inspection and condition assessment of electric, fire protection, air quality, and moisture failures and control systems.

Research

- Assessment of novel strategies and building materials that reduce energy consumption, pollutant concentration, and noise level in buildings.

Typical Employers

- Consulting engineering firms,
- Construction management companies,
- Architecture offices,
- Facilities authorities,
- Building system product manufacturers,
- Building code authorities.
- Testing laboratories,
- General contractors and specialty mechanical and lighting contractors.
- Management consulting firms involved in construction dispute and claims analysis.

Example Career Paths

In a consulting engineering firm, initial assignments would involve work with a senior engineer, typically on the cooling and heating load calculation and on the design of parts of environmental systems, such as ductwork and plumbing systems. In the next phase, the assignment could involve the analysis of the energy performance and life cycle cost analysis for different types of buildings as well as evaluation of different green building sustainability strategies. With involvement in different types of projects, the experience level would increase bringing higher rank and more responsibilities. By getting a PE license, building energy and environment engineers typically become responsible for environmental systems on larger projects and the duties could include management, business development, relationship with clients, project budgeting, and project staffing. Senior position responsibilities could also involve monitoring of the construction and work with architects, owner's representatives, and owner's facility staff. In the later phase



of career the building energy and environment engineers may become involved with forensic investigations, new technology development and/or service as the in-house technical expert for large companies.

Educational Background and Licensing Requirements

- Students interested in specializing in building energy and environments should be familiar with all the building systems and the construction processes. As elective courses they should select courses related to the building environmental systems and indoor air quality. In addition to ArE courses, students should take a mechanical engineering course in heat transfer as many environmental systems analyses are grounded in fundamental principles of the thermal sciences. Further broadening the engineer's knowledge by taking various courses in fundamental science could be very useful for a career that includes research and product development.
- For the successful career, a Professional Engineer's (PE) license is generally a requirement. The first step is to pass the Fundamentals of Engineering (FE) exam, and general recommendation is to take this exam as a senior student. In most states (including Texas), after at least four years of relevant experience one can take the Principles and Practice Examination in either Architectural, Environmental, Mechanical, or Electrical Engineering, depending on the area of work specialization.
- Advanced degrees are recommended for those who want to be engaged in challenging problems earlier in their career. Many universities, such as UT, offer specialized programs in building environmental systems for students pursuing M.S. or Ph.D. degrees. Also, the University of Texas at Austin offers a unique graduate program in Indoor Environmental Science and Engineering studies for students interested in this subject.
- Students who are interested in green and sustainable buildings should consider become a Leadership in Energy and Environmental Design (LEED), <http://www.usgbc.org/LEED/> accredited professional.

Major Professional Societies (in alphabetical order)

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE),

<http://www.ashrae.org/>

Architectural Engineering Institute (AEI),

<http://content.aeinsteinstitute.org/inside/intro.html>

Illuminating Engineering Society of North America (IESNA),

<http://www.iesna.org/>

International Society of Indoor Air Quality and Climate (ISIAQ)

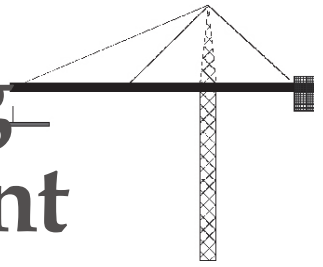
<http://www.isiaq.org/>

United States Green Building Council (USGBC)

<http://www.usgbc.org/>

Area of Practice

Construction Engineering & Project Management



This area of practice, in general, tends to be more practical than theoretical. Excellent, broad-based people skills, as well as strong technical skills, are needed for success. Work on a project site is generally required, which provides outdoor work and the opportunity to interact with the various crafts. In a large company, this career path may offer opportunities for assignments at project sites in many locations, including international assignments. Frequent relocation or extended periods away from home are the norm with most large, national and international companies. Medium to smaller regional companies offer similar opportunities, but may allow career development through regional offices and hence require less relocation.

Typical Engineering Positions

Field Engineer	Cost Engineer
Project Superintendent*	Construction Administrator
Estimator	Project Manager*
Project Engineer	Scheduler
Operations Manager*	Project Controls Engineer
Construction Manager*	Project Executive*

* These positions typically require considerable experience

Tasks and responsibilities will vary depending on the type of employer and the experience of the employee. Even between similar types of firms, tasks will differ. Tasks that engineers may perform during their career include:

Project Planning	Estimating
Scheduling	Drawings/Plan Reviews
Labor Relations	Procurement
Value Engineering	Cost Analysis
Inspection	Constructability Analysis
Surveying & Layout	Leadership & Management
Contract and Subcontract Negotiations & Writing	
Materials Testing Coordination and/or Supervision	
Coordination of Construction Activities	
Recruiting, Hiring, Supervising & Training Craft Personnel	

In addition, certain companies may have engineers perform design functions. This work may include:

- Design, checking, and analysis of parts of or entire projects to be built.
- Construction systems or methods such as formwork for concrete,

reinforcing steel for lifting precast and tiltwalls, shoring, use of cranes and lifting devices.

- Supervising design work performed by other architecture or engineering firms or by in-house personnel.

Some of the unique capabilities that engineers can provide when they are employed by the construction industry are:

- Problem-solving ability
- Understanding of how the facility/structure/project to be constructed has been designed and how it will function
- Understanding business and technical relationships and the importance of communication and interaction between owners, contractors, sub-contractors, and suppliers
- Appreciation of the total process, teamwork, and coordination required by all parties to successfully design and build the project on schedule and budget

Typical Employers

• **Construction Companies/Contractors:**

- Types of firms include those who may specialize in one or more types of work including buildings, highways, bridges, utilities, power, petro-chemical, industrial, sanitary plants, mechanical, electrical and other trade specialties.
- Some construction companies, known as general contractors or Engineering, Procurement, and Construction (EPC) firms perform both design engineering and construction. They may employ engineers to do the design or outsource it to design/engineering firms and then direct and oversee their work. These companies are large and have a global presence. However, most of the construction firms in the USA build projects that have been designed by separate engineering and/or architectural companies.
- Generally, construction companies are required to sign contracts that require them to assume substantial risk by guaranteeing a price and completion date.

- **Industry:** These companies, also known as owner companies, may employ engineers to perform various project and construction functions related to their operations, process plants, manufacturing or facilities. Engineers may serve in roles where they are directly involved in the planning, contracting, engineering, estimating, inspecting, directing, and/or overseeing construction.



- **Multi-Unit Housing & Residential Construction:** A majority of companies in this country who build housing projects perform the construction functions in-house. Engineers often fill positions in planning, estimating and supervising construction.
- **Governmental:** Many government agencies employ engineers in various capacities to plan, estimate, supervise, coordinate, inspect and/or perform contract administration functions. Employers include municipalities, counties, state and federal agencies.
- **Military:** The Army, Navy and Air Force all have major construction programs and employ engineers either in a military or civilian capacity. All of these services have units of military construction personnel that are supervised by military officers who normally have engineering degrees. The Army and Navy have large construction contracting programs and employ engineers to perform many functions including planning, estimating and contracting. The Army Corps of Engineers has a major civil engineering/public works program throughout the USA.
- **Program & Project Management Firms:** Program and project management firms often are independent firms who work for an owner to perform various functions which may include planning, budgeting, estimating, contract negotiation and administration and inspection. They normally work for a fee and/or on cost reimbursable basis and are not at risk/responsible for the construction cost of the project, in contrast to construction companies.
- **Developers:** Companies that develop and build projects such as office buildings and retail projects may employ engineers. Generally engineers employed by these companies have gained prior experience in other construction or engineering areas.

Example Career Paths

- **Entry Level Positions:** Entry level positions could include positions in construction administration, project controls, assisting in estimating, material procurement, materials expediting, scheduling, cost control, limited project management responsibility, field layout, inspection of in-process and completed work, resolution of design issues encountered during construction, providing technical direction to crafts, labor, and subcontractors.
- **Advancement:** An experienced engineer may advance to a position of managing all field engineering activities on a large, complex project. Responsibilities might include quality control and progress reporting. The engineer's responsibilities might also include labor management. In this role, the engineer may be the superintendent for a specific area, such as civil work, earthwork, concrete, or structural steel. An engineer may be given a project assignment in scheduling, cost or estimating. Over time, the engineer would gain experience in many areas on increasingly complex projects. Later in a career, an engineer may become a project superintendent responsible for the work of all disciplines including concrete, steel, piping, mechanical and electrical. An engineer may advance further to become a site construction manager, responsible for all activities at the jobsite. After demonstrating competency in all areas of

project management, an engineer may be offered the opportunity to be a business manager or operations manager on a project, responsible for monitoring and accurately reporting all cost and schedule performance on a project. As an engineer demonstrates the ability to successfully lead and manage clients, employees and work quality, budget and schedule, areas of responsibility may increase to include all activities on large, complex projects, including engineering, procurement and construction, which are typically managed by a project manager or project executive. Later an engineer may manage an entire office. Eventually a construction engineer can be president of a construction company or become a general manager or vice president in some of the largest companies in the United States.

Educational Background and Licensing Requirements

Students should emphasize elective courses in the areas of project management, estimating, scheduling, contracts and business. An alternate is to take additional engineering courses in varied subjects so as to broaden the engineer's understanding in various areas. Examples might include foundation engineering, pavement design, steel and concrete design, building environmental systems, and hydraulics. The ability to work toward obtaining a P.E. license depends on the employer and the work assignments. An advanced degree in Construction Management or an MBA might enhance one's career in construction. However, before doing this an engineer should investigate the various construction career opportunities and employers to see if and when the advanced degree will be most beneficial. Engineering students without a strong background in project management related courses may also benefit from a Master's degree concentration in construction engineering and/or management to speed entry into the construction industry.

Major Professional Societies

- American Institute of Constructors (AIC);
<http://www.aicnet.org>
- American Society of Civil Engineers (ASCE);
<http://www.asce.org>
- Associated General Contractors of America (AGC);
<http://www.agc.org>
- Association for the Advancement of Cost Engineering (AACE);
<http://www.aacei.org/>
- Construction Industry Institute (CII);
<http://www.construction-institute.org>
- Design/Build Institute of America (DBIA);
<http://www.dbia.org>
- Project Management Institute (PMI);
<http://www.pmi.org/info/default.asp>

Area of Practice

Construction Materials



A thorough understanding of key construction materials, such as asphalt, concrete, steel, masonry, and composites, is essential to ensuring a long-lasting infrastructure. Engineers who specialize in materials are integral parts of design, construction, and forensics firms. Although some materials experts are versed in a range of materials, most tend to specialize in certain areas. For instance, engineers often specialize, for example, in asphalt for road construction or concrete for pavements, bridges, or buildings. Materials engineers typically work in close cooperation with structural engineers to integrate the use of innovative materials in construction or with other specialized areas of civil and environmental engineering.

Typical Engineering Positions

- Materials selection, specification and design: selection and design of materials for specialty applications and environments, design of concrete mixes, batch plant oversight, selection of grade for structural steel applications, design and specification of welding procedures, specification of composites for specialty applications.
- Materials performance: testing and qualification of materials for service, fracture and fatigue analyses and designs, finite element analysis of complex structural components, failure investigations.
- Construction quality assurance: specification and oversight of concrete, steel and soil materials testing programs for quality assurance during construction.

Typical Employers

- Consulting engineering firms
- Construction companies
- Highway and other governmental authorities responsible for civil infrastructure
- Industries with unique materials requirements (e.g., oil, chemical)
- Testing laboratories (for QC/QA tests associated with construction projects)
- Forensics firms (for determining the cause of structural failures or distress)

Example Career Paths

In a consulting engineering firm, initial assignments would involve assisting with mix design or material selection, design of QA programs for small construction projects, and oversight of field personnel performing QA testing. With increasing experience, responsibilities would grow to overall accountability for material QA on large projects. Later in their careers materials engineers may become involved with forensic investigations of materials-related failures, selection of materials for unique or exotic uses, or serve as the in-house technical expert for a large design firm or oil company.

Educational Background and Licensing Requirements

In addition to CE courses, students should take some ME courses in metallurgy, corrosion, and welding (if not available in CE), and coursework to understand the composition, performance and uses of composites (may be taught in Chem E or ME). Advanced degrees are recommended for those who want to be engaged in challenging problems earlier in their career. Some Universities, such as UT, offer specialized programs in construction materials for students pursuing MS or Ph.D. degrees.

Major Professional Societies (in alphabetical order)

American Concrete Institute (ACI),
<http://www.concrete.org>
American Institute of Steel Construction, Inc. (AISC),
<http://www.aisc.org/>
American Iron and Steel Institute (AISI),
<http://www.steel.org/>
Post-Tensioning Institute (PTI),
<http://www.post-tensioning.org/>
Precast/Prestressed Concrete Institute (PCI),
<http://www.pci.org/>
Structural Engineers Association of Texas (SEAoT),
<http://www.seaot.org/>
Transportation Research Board (TRB),
<http://www.trb.org>

Area of Practice

Structural Engineering



Structural engineers generally establish the geometrical layout and member proportions of structural systems to economically resist the forces induced on the structure throughout its life. Design forces are dependent on the type of structure as well as the geographic location and can result from a variety of sources including gravity, wind, waves, or earthquakes. Structural engineers must be familiar with the behavior and interaction of different materials such as steel, concrete, masonry or wood so that they can proportion and combine the materials to produce innovative solutions to challenging problems. Structural engineers often work with architects, builders, and engineers from other disciplines to organize and supervise the construction of large-scale projects. Structural engineers also analyze the capacity and condition of existing structures, investigate the causes of structural failures, and design retrofits to problematic systems.

Typical Engineering Positions

Design

- Design of building superstructures, garages, foundations, bridges, offshore and marine structures, and industrial facilities.
- Repair, rehabilitation, and strengthening of existing facilities, historic structures, and aging infrastructure.

Analysis

- Analysis of structures subjected to gravity, lateral (earth, wind, and seismic), vehicular, vibration, blast, and fluid loads.

Safety Inspection; Forensics; Investigation

- Inspection and condition assessment of existing structures.
- Evaluation of serviceability, durability, stability, and strength problems with structures.

Research

- Assessment of new and novel structural materials and systems and advanced applications of conventional structural materials and systems.


Computer Programming

- Development of structural engineering software.

Typical Employers

- Consulting engineering firms.
- Oil, petrochemical, and other major industrial companies.
- Large engineering/procurement/construction (EPC) contractors.
- Architectural and engineering (AE) firms.
- Federal, state, and local transportation agencies.
- Regional transportation toll authorities.
- Building code authorities.
- Industry associations.
- General contractors and specialty structural contractors.
- Real estate owners and developers of significant and high profile structures.
- Management consulting firms involved in construction dispute and claims analysis.

Example Career Paths and Project Activities

- At the beginning of their careers, structural engineers work under licensed professional engineers (P.E.) or structural engineers (S.E.) designing small structures or components of more complex structures. Structural engineers are expected to determine applicable loads, determine load paths, analyze the structure or component for maximum load effects, and size and select members to resist maximum load effects and ensure compliance with applicable building codes. Typical project activities include design modeling, calculations, fieldwork, and extensive oral and written communication.
- Subsequent to professional registration, a structural engineer will be responsible for selection of appropriate systems for structural efficiency that meet project budgetary constraints. At this level, the structural engineer will generally work independently or in a small team led by a senior structural engineer. The engineer may supervise other engineers-in-training (E.I.T.).
- After a decade or more experience, a structural engineer may be in responsible charge of advanced and complex projects, leading a large team or division of structural engineers. The individual will generally be responsible for resource allocation from start to finish, project scheduling, and monetary profit or loss. The individual will be responsible for setting direction, developing proposals for new work, maintaining existing clients, and addressing problems.
- In a large company, an experienced structural engineer may advance to a position of managing all engineering activities on a large, complex project, including other disciplines such 

architectural, mechanical, and electrical.

- A senior engineer may specialize in a technical area, such as seismic analysis of LNG tanks, or cold weather design of dynamically loaded structures. A technical expert in a large company has the opportunity to solve unique problems in projects located all around the world. An engineer may also participate in code committees, speak at conferences, write papers, and influence future engineering research and design.
- As an engineer demonstrates ability to manage clients, employees and work quality, budget and schedule, areas of responsibility may increase to include all activities on large, complex projects, including engineering, procurement and construction. Later an engineer may manage an entire office. Eventually a structural engineer can become a general manager, partner, and owner in businesses ranging from small consulting firms to some of the largest companies in the US.

Licensing Requirements and Educational Preparation

- To advance in a career in structural engineering, a Professional Engineer's (PE) license is generally a requirement.
- To become licensed, the structural engineering student should take the Fundamentals of Engineering (FE) Examination as a junior or senior. In most states (including Texas), after at least four years of relevant experience one can take the Principles and Practice Examination in either Civil Engineering or Structural Engineering (see the subject list from a recent "Structural I" P.E. exam). Upon passing this exam, the structural engineer becomes a licensed Professional Engineer. In some states, such as Illinois, California, and Washington, in order to practice all aspects of structural engineering, an additional examination is required for registration as a Structural Engineer (S.E.)
- For a career in structural engineering, a master's degree is encouraged, and is almost essential to pass the Principles and Practice Examination. Some employers encourage continuing education, even paying for a portion of tuition to obtain a master's degree while working; however, many employers require students to complete their education prior to commencing work. With a master's degree, one can generally take the Principles and Practice Examination after three years of experience.
- To be prepared for the exam and a career in structural engineering, student should take as many Level I and Level II electives in structural engineering as possible, along with a course in foundation engineering.

Major Professional Societies (in alphabetical order)

American Concrete Institute (ACI),

<http://www.aci-int.org/>

American Institute of Steel Construction, Inc. (AISC),

<http://www.aisc.org/>

American Iron and Steel Institute (AISI),

<http://www.steel.org/>

American Segmental Bridge Institute (ASBI),

<http://www.asbi-assoc.org/>

National Concrete Bridge Council (NCBC),

<http://www.nationalconcretebridge.org/>

National Society of Professional Engineers (NSPE),

<http://www.nspe.org/>

National Steel Bridge Alliance (NSBA),

<http://www.aisc.org>

Post-Tensioning Institute (PTI),

<http://www.post-tensioning.org/>

Precast/Prestressed Concrete Institute (PCI),

<http://www.pci.org/>

Structural Engineers Association of Texas (SEAoT),

<http://www.seaot.org/>

Structural Engineering Institute of ASCE,

<http://www.seinstitute.org/>

Organizations Recently Hiring BSARE Graduates

AG&M
Aguirre and Fields
Aker Kvaerner
Americorps
Arcadis
Architectural Engineers Collaborative
Architectural Wall Systems
Austin Commercial Inc.
Axis Design
Bartlett Cocke General Contractors
Bechtel Inc.
Bill Reiffert & Associates
Brockette/Davis/Drake, Inc.
Brown & Gay Engineers Inc
Burlington Northern Santa Fe
Bury & Partners
C.F. Jordan
Carrasquillo Associates
Carter & Burgess
Chiang, Patel & Yerby Inc.
Commercial Siding
Coreslab Structures
DPIS Engineering
DPR Construction Inc.
Durotech
Encotech Engineering, Inc.
Flynn Construction
Freese & Nichols Inc.
Gilbane Building Company
Halff Associates Inc.
Hatchmott McDonald
Hensel Phelps Construction Co.
HKS, Inc.
HNTB Corporation
HVJ Associates, Inc.
Interface Consulting

J F Thompson, Inc.
J.D. Abrams
Jones & Carter, Inc.
Kiewit Texas Construction
L.A. Fuess Partners
Linbeck Construction Corp.
Lockwood, Andrews, and Newnam,
Lower Colorado River Authority
MACTEC Engineering & Consulting Inc.
McCarthy Building Companies Inc.
Middlesex Companies
MW Cude Engineers
Parkin, Perkins, Olsen Co
Pate Engineers Inc.
Redding Linden Burr
Rodriguez Engineering Labs
Schultz Group, Inc.
SGH
Silent Technologies
Simpson Gumpertz & Heger, Inc.
Steinman Luevano Structures
Stone & Webster
T & T Engineering
TAC Americas, Inc.
Teach for America
Texas Dept of Transportation
The Austin Company
Thornton Tomasetti/LZA
Turner Collie & Braden
Turner Construction Company
URS Greiner Woodward Clyde
Wallace Engineering
White Construction
Winkelmann and Associates
Wylie Consulting Engineers
