ASU • Ira A. Fulton
Schools *of* Engineering

ARIZONA STATE UNIVERSITY

school of sustainable engineering and the built environment

civil, environmental and sustainable engineering

Structures and Materials

The Structures/Materials Program encompasses a multitude of areas such as structural analysis and design, steel and concrete structures, timber and masonry structures, matrix and computer methods, buildings, bridges and dams, power plant design, wind analysis and design, finite element method, earthquake analysis and design, stability of structures, nonlinear structural analysis, structural failure, prestressed concrete structures, lifeline analysis and design, applied optimal design, probabilistic methods, structural dynamics, composite materials, stress analysis, cement based materials, experimental methods etc.
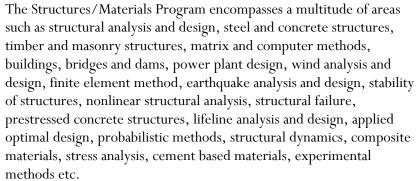
Recent graduates have been employed in a variety of different organizations and companies both in the private and the public sector. Job opportunities include small and large consulting firms that deal with structural analysis and design, federal agencies and laboratories such as Federal Highway Administration (FHWA), Bureau of Reclamation (BUREC), Corps of Engineers, Air Force, Army, Navy, NASA, U.S.Geological Society, Sandia Labs etc., state agencies such as Arizona Department of Transportation (ADOT), county and city engineering offices etc., large companies such as Shell Oil, Boeing, Honeywell, Motorola, Intel, Ford, Tesla, General Motors etc. and small companies that deal with structural problems. As can be seen by the list, the employment and career opportunities span the spectrum and are not limited to certain specialty government agencies or private sectors, or to certain geographical regions.

STRUCTURES FACULTY

- Apostolos Fafitis, Emeritus Professor
- Keith Hjelmstad, Professor
- Christian Hoover, Associate Professor
- Barzin Mobasher, Professor
- Narayanan Neithalath, Professor
- Subramaniam Rajan, Professor (Specialty Area Coordinator, SAC)
- Ravi Yellavajjala, Associate Professor

LIST OF APPROVED COURSES

Graduate Structures Courses

CEE515 Design and Behavior of Portland Cement Concrete Mixtures
CEE521 Stress Analysis
CEE523 Structural Damage Evaluation and Strengthening
CEE524 Advanced Steel Design
CEE525 Design of Composites for Infrastructure
CEE526 Finite Elements for Engineers
CEE527 Advanced Concrete Structures
CEE528 Advanced Mechanics of Materials
CEE529 Cohesive Fracture Mechanics
CEE530 Prestressed Concrete
CEE532 Developing Software for Engineering Applications
CEE533 Structural Optimization
CEE536 Structural Dynamics
MAE513 Polymer and Composites
MAE524 Theory of Elasticity
MAE557 Mechanics of Composite Materials

Courses Qualifying for the Minor Area Requirement

Civil Engineering
CEE550 Soil Behavior
CEE553 Advanced Soil Mechanics
CEE554 Shear Strength and Slope Stability
CEE555 Advanced Foundations
CEE559 Earthquake Engineering
CEE598 Machine Learning Techniques in Civil Engineering

Industrial Engineering
IEE572 Design of Engineering Experiments
IEE578 Regression Analysis
IEE582 Response Surfaces and Process Optimization

Materials Engineering
MSE512 Analysis of Material Failures
MSE516 Mechanical Behavior of Materials
MSE540 Fracture, Fatigue, and Creep

Computer Science & Engineering
CSE526 Parallel Processing
CSE570 Advanced Computer Graphics I
CSE573 Advanced Computer Graphics II

Courses Qualifying for the Math Requirement

MAE501 Linear Algebra in Engineering
MAE502 Partial Differential Equations in Engineering
MAT521 Iterative Methods
MAT523 Numerical Optimization
MAT524 Parallel Numerical Algorithms
MAT530 Numerical Solution of Ordinary Differential Equations
MAT533 Computational Elliptic and Parabolic Differential Equations
MAT576 Theory of Partial Differential Equations

M.S. PROGRAM

The degree program requires 30 credit hours. There are three culminating experience options - thesis, applied project, and comprehensive exam. The student will select one of these options by consulting the Specialty Area Coordinator (SAC) of the structures group.

1.0 Thesis/Applied Project

Thesis Only: The advisor, in consultation with the student, will establish a Graduate Supervisory Committee (GSC). The GSC shall be composed of a minimum of three members from the CEE tenure-track faculty with at least two being from the Structures Group. Participation of individuals from institutions external to the ASU is encouraged but these shall be non-voting members. The advisor shall serve as the chair of the GSC. The Plan of Study (POS) must be in accordance with Graduate College and CEE requirements.

Applied Project Only: The advisor alone will form the GSC.

Thesis/Applied Project: The candidate must complete at least 30 credit hours of approved course and research work distributed as follows:

1) at least fifteen (15) hours of Graduate Structures courses covering at least one course from the 4 core areas listed in Section 2.0.
2) at least three (3) but no more than six (6) hours in a minor area
3) at least three (3) but no more than six (6) hours of mathematics
4) <u>Thesis only</u>: Not more than three (3) hours of CEE590 and 6 hours of thesis (CEE599).
5) <u>Applied Project only</u>: Three (3) hours of CEE593.

2.0 Comprehensive Exam

The Graduate Supervisory Committee (GSC) shall consist of all tenure-track Structures faculty. The advisor shall serve as the chair of the GSC. The Plan of Study (POS) must be in accordance with Graduate College and CESE requirements. The candidate must complete at least 30 credit hours of approved course work distributed as follows:

1) at least twenty one (21) hours of Graduate Structures courses including the core courses
2) at least three (3) but no more than six (6) hours in a minor area
3) at least three (3) but no more than six (6) hours of mathematics

A final written comprehensive exam is administered by the Structures Group the week before the last week of classes during the Fall and Spring semesters. The final exam is a comprehensive exam covering four core areas. Students must demonstrate mastery in all four areas.

<u>Area 1. Structural Mechanics</u> covering material from a graduate level course in mechanics of materials (e.g., CEE521) and structural dynamics (e.g., CEE536). Student must show proficiency in either advanced mechanics of materials or structural dynamics.

<u>Area 2. Structural Analysis and Engineering Mathematics</u> covering material from a graduate level course in engineering mathematics (MAE501 or MAE502) and structural analysis (e.g., CEE532 or CEE526).

<u>Area 3. Structural Design</u> covering material from a graduate level course in concrete design (e.g., CEE527), steel design (e.g., CEE524) and prestressed concrete design (e.g., CEE530). Student must show proficiency in design using either concrete or steel.

<u>Area 4. Structural Materials</u> covering material from a graduate level course in material characterization and behavior (e.g., CEE515, CEE523, CEE525).

It is important for all doctoral students to read the [Civil, Environmental and Sustainable Engineering Ph.D. program manual.](#)