Civil Engineering (CVEG)

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Civil Engineering website (http://cveg.uark.edu)

Degrees Conferred:
M.S.C.E. in Civil Engineering (CVEG)
M.S.En.E. in Environmental Engineering (ENEG) (See Environmental Engineering (http://catalog.uark.edu/graduatecatalog/programs/ofstudy/environmentalengineeringeneg))
Ph.D. in Engineering (CVEG) (See Engineering (http://catalog.uark.edu/graduatecatalog/programs/ofstudy/engineeringcollegeofengr))

Program Description: The Master of Science in Civil Engineering program is intended primarily for students possessing the Bachelor of Science in Civil Engineering degree. Students with degrees from other engineering disciplines may be admitted to the program but will be required to complete some undergraduate civil engineering courses as preparation for their graduate studies. The specific courses required will depend on the emphasis of their graduate studies. The objectives of the M.S.C.E. program are to provide a greater depth of understanding of civil engineering topics for the practice of engineering and to serve as preparation for doctoral studies. Students are allowed a great deal of flexibility in designing their course of study. Students desiring to develop a deeper understanding of one sub-discipline area may select courses solely concentrated in that area while those desiring a broader-based education may select courses from several sub-disciplines including courses from other disciplines.

Primary Areas of Faculty Research: The Department of Civil Engineering has ongoing research programs in the environmental/water resources, geotechnical, structural, and transportation areas. The following is a more detailed listing of topics currently being studied in each of these areas:

- **Environmental/Water Resources Area:** Water and wastewater treatment; decentralized collection and treatment systems; soil and groundwater remediation; surface and ground water quality; storm water pollution prevention; environmental and hydrologic modeling; water quality studies.

- **Geotechnical Area:** Aggregates and base materials; geosynthetic reinforcement; embankment and slope stability; field instrumentation and measurement of soil properties; soil and groundwater remediation using geosynthetics; GIS application to geotechnical engineering; foundation design.

- **Structural Area:** High performance concrete; structural materials; bridge deck rehabilitation; computational mechanics; computational wind engineering and tornado modeling; structural earthquake analysis and modeling; structural steel design and analysis.

- **Transportation Area:** Facility design; roadway geometrics; traffic operations and safety; pavement design and rehabilitation; asphalt concrete mixture design; construction materials characterization; construction quality control; geosynthetic reinforced flexible pavements; transportation management systems; high-speed pavement condition data acquisition; and transportation and land development.

In addition to these core areas, the Department of Civil Engineering is also actively pursuing research in the areas of alternative energy sources, infrastructure security, nanotechnology, and sustainability.

**M.S.C.E. in Civil Engineering**

Requirements for the Master of Science in Civil Engineering Degree:
Minimum 30 semester hours of graduate-level credit for thesis option; or 30 semester hours of graduate-level non thesis or research credit for course work only option.

1. Candidates for the degree who present a thesis are required to complete a minimum of 24 semester hours of course work and a minimum of six semester hours of thesis.
2. Candidates for the degree who do not present a thesis are required to complete a minimum of 30 semester hours of graduate-level course work.
3. Candidates for the degree must present a cumulative grade point average of 3.00 on all graduate courses. The minimum acceptable grade for any course is "C."
4. Upon admission to the Graduate School and acceptance in a program of study, candidates pursuing a thesis-based program will be assigned to a major adviser, who in consultation with the department head, will select a graduate committee. With guidance from the committee, the candidate will develop a plan of study and a research project to be completed by the candidate. The committee will serve as the examination committee for the final oral and/or written examination and for the thesis. Candidates pursuing a coursework-based program will be assigned to a major adviser, who will assist the candidate in developing a plan of study; the major adviser will coordinate the final and/or written examination.
5. All graduate students enrolled in the M.S.C.E. program in the Department of Civil Engineering must successfully complete one semester of CVEG 5100 Graduate Seminar in Civil Engineering.

Students should also be aware of Graduate School requirements with regard to master's degrees (http://catalog.uark.edu/graduatecatalog/degreerequirements/#mastersdegree/text).

**Ph.D. in Civil Engineering**

Requirements for the Doctor of Philosophy (Ph.D.) degree with emphasis in Civil Engineering: Minimum 72 semester hours of graduate-level credit beyond the baccalaureate degree; minimum 42 semester hours of graduate-level course work.

1. Candidates for the degree are required to complete a minimum of 36 semester hours of graduate-level course work and a minimum of 18 semester hours of dissertation. Graduate-level course work comprising an earned master’s degree may be included in the minimum course work credit hours for the Ph.D. degree.
2. Candidates for the degree must present a cumulative grade point average of 3.00 on all graduate courses. The minimum acceptable grade for any course is "C."
3. All graduate students enrolled in the Ph.D. program in the Department of Civil Engineering must successfully complete two semesters of CVEG 5100 Graduate Seminar in Civil Engineering.
Students should also be aware of Graduate School requirements with regard to doctoral degrees (http://catalog.uark.edu/graduatecatalog/degreerequirements/#phdandeddgreestext).

**Graduate Faculty**

**Bernhardt, Michelle**, Ph.D., M.S.C.E., B.S.C.E. (Texas A&M University), Assistant Professor, 2013.

**Braham, Andrew F.**, Ph.D. (University of Illinois-Urbana-Champaign), M.S., B.S. (University of Wisconsin-Madison), Assistant Professor, 2010.

**Coffman, Rick**, Ph.D. (University of Missouri-Columbia), M.S. (University of Texas at Austin), B.S. (University of Wyoming), Associate Professor, 2009.

**Dennis, Norman D.**, Ph.D. (University of Texas at Austin), M.B.A. (Boston University), M.S.C.E., B.S.C.E. (Missouri University of Science and Technology), University Professor, 1996.

**Edwards, Findlay**, Ph.D. (New Mexico State University), M.S. (University of New Mexico), M.S.C.E. (New Mexico State University), Associate Professor, 1999.

**Fairey, Julian**, Ph.D., M.S.C.E. (University of Texas at Austin), B.S.C.E. (University of Alberta, Canada), Associate Professor, 2008.

**Fernstrom, Eric**, Ph.D. (University of Arkansas), Instructor, 2014.

**Gattis, J. L.**, Ph.D. (Texas A&M University), M.S.C.E. (University of Texas Arlington), B.S.C.E. (University of Arkansas), Professor, 1993.


**Hall, Kevin D.**, Ph.D. (University of Illinois-Urbana-Champaign), M.S.C.E., B.S.C.E. (University of Arkansas), Professor, 1993.

**Hernandez, Sarah**, Ph.D., M.S. (University of California, Irvine), B.S. (University of Florida), Assistant Professor, 2015.

**Heymsfield, Ernie**, Ph.D. (City University of New York), M.S.C.E. (Polytechnic University), Associate Professor, 2001.


**Selvam, R. Panneer**, Ph.D. (Texas Tech University), M.S.C.E. (South Dakota School of Mines and Technology), M.E., B.E. (University of Madras, India), University Professor, 1986.

**Williams, Rodney D.**, Ph.D., M.S., B.S.C.E. (University of Arkansas), Assistant Professor, 1998.

**Wood, Clinton M.**, Ph.D. (University of Texas at Austin), M.S.C.E., B.S.C.E. (University of Arkansas), Assistant Professor, 2013.

**Zhang, Wen**, Ph.D. (Purdue University), M.S. (University of Kansas), Assistant Professor, 2011.

**Courses**

**CVEG 4253. Small Community Wastewater Systems. 3 Hours.**
Design of innovative and alternative wastewater collection, transport, and treatment systems typically suited for rural and small community applications. Recitation 3 hours per week. Prerequisite: CVEG 3243.

**CVEG 4393. Reinforced Concrete Design II. 3 Hours.**
Shear strength, minimum thickness requirements, and deflection calculations for reinforced concrete structural slabs. Design of one-way and two-way structural slabs by the direct design and equivalent frame methods. Prerequisite: CVEG 4303 with a grade of C or better.

**CVEG 5100. Graduate Seminar in Civil Engineering. 0 Hours.**
A weekly seminar devoted to civil engineering research topics. Appropriate grade to be “S”.

**CVEG 5113. Soil Dynamics. 3 Hours.**
This course covers propagation of stress waves in elastic and inelastic materials, dynamic loading of soils, and stiffness and damping properties of soils. Use of field and laboratory techniques to determine shear wave velocity of soils. Also includes applications of dynamic soil properties in site stiffness characterization, geotechnical earthquake engineering, evaluation of ground improvement, and design of machine foundations. Prerequisite: CVEG 4143 with a grade of C or better.

**CVEG 5123. Measurement of Soil Properties. 3 Hours.**
Consideration of basic principles involved in measuring properties of soils. Detailed analysis of standard and specialized soil testing procedures and equipment. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: CVEG 4143 with a grade of C or better.

**CVEG 5143. Transportation Soils Engineering. 3 Hours.**
Advanced study of the properties of surficial soils; soil classification systems; pedology; soil occurrence and variability; subgrade evaluation procedures; repeated load behavior of soils; soil compaction and field control; soil stabilization; soil trafficability and subgrade stability for transportation facilities. Prerequisite: CVEG 3133 with a grade of C or better.

**CVEG 5163. Seepage and Consolidation. 3 Hours.**
Investigation of the flow of water through soils and the time rate of compression of soils. Characterization of the hydraulic conductivity of soils in the field, seepage through earth dams, excavation cut-off walls, and other seepage control systems. Analytical and experimental investigations of soil volume change under hydraulic and mechanical loading. Design of earth and rock dams, well pumping, and vertical and radial consolidation in embankments. Prerequisite: CVEG 4143 with a grade of C or better.

**CVEG 5173. Advanced Foundations. 3 Hours.**
Study of soil-supported structures. Topics include drilled piers, slope stability, pile groups, negative skin friction, foundation design from the standard penetration test and Dutch cone, and other specialized foundation design topics. Prerequisite: CVEG 4143 with a grade of C or better.

**CVEG 5183. Geo-Environmental Engineering. 3 Hours.**
Study of the geotechnical aspects of waste containment systems and contaminant remediation applications. Analysis and measurement of flow of water and contaminants through saturated and unsaturated soils, clay mineralogy and soil-chemical compatibility, and mechanical and hydraulic behavior of geomembranes, geotextiles, and geosynthetic clay liners. Design and construction aspects of compacted clay and composite landfill liners, drainage systems, and landfill covers. Prerequisite: CVEG 3133 with a grade of C or better.

**CVEG 5193. Geotechnical Earthquake Engineering. 3 Hours.**
This course covers stress wave propagation in soil and rock; influence of soil conditions on seismic ground motion characteristics; evaluation of site response using wave propagation techniques; liquefaction of soils; seismic response of earth structures and slopes. Prerequisite: CVEG 4143 with a grade of C or better.

**CVEG 5203. Water Chemistry. 3 Hours.**
This course provides a basis for applying principles of physical chemistry to understanding the composition of natural waters and to the engineering of water and wastewater treatment processes. Topics covered include chemical equilibrium (algebraic, graphical, and computer-aided solution techniques); acid-base equilibria and buffering; oxidation and reduction reactions; and solid precipitation and dissolution. Prerequisite: Graduate standing or CVEG 3243 and instructor approval.

**CVEG 5213. Water Treatment & Distribution System Design. 3 Hours.**
Design of industrial and municipal water treatment plants. Discussion of raw and treated water requirements for the several uses. Distribution system analysis and design including distribution storage and pumping. Prerequisite: CVEG 3243 with a grade of C or better.
CVEG 5214. Advanced Wastewater Process Design and Analysis. 4 Hours. Application of advanced techniques for the analysis of wastewater treatment facilities. Physical, chemical and biological processes for removing suspended solids, organics, nitrogen, and phosphorus. Laboratory treatability studies will be used to develop design relationships. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: CVEG 4243 with a grade of C or better.

CVEG 5233. Microbiology for Environmental Engineers. 3 Hours. Fundamental and applied aspects of microbiology and biochemistry relating to water quality control, wastewater treatment, and stream pollution. Prerequisite: CVEG 3243 with a grade of C or better.

CVEG 5243. Groundwater Hydrology. 3 Hours. Detailed analysis of groundwater movement, well hydraulics, groundwater pollution and artificial recharge. Surface and subsurface investigations of groundwater and groundwater management, saline intrusion and groundwater modeling will be addressed. Prerequisite: CVEG 3223.

CVEG 5253. Physical-Chemical Processes for Water and Wastewater Treatment. 3 Hours. This course provides a fundamental understanding of physical and chemical processes used in the treatment of drinking water and wastewater. Principals of mass balance are applied to understand the impact of reactor hydraulics (ideal and non-ideal flow) and reaction kinetics on process performance and identity important process variables. Chemical processes covered include disinfection, gas transfer, adsorption, and ion exchange; physical processes covered include coagulation, flocculation, sedimentation, filtration, and membranes. Prerequisite: Graduate standing and instructor consent.

CVEG 5273. Open Channel Flow. 3 Hours. Open Channel Flow includes advanced open channel hydraulics, flow measurement techniques, a hydrology review, culvert and storm drainage facility design, natural channel classification (fluvial geomorphology) and rehabilitation, computer methods and environmental issues. Prerequisite: CVEG 3213 and CVEG 3223.

CVEG 5293. Water Reuse. 3 Hours. CVEG 5293 is a graduate-level course that discusses topics related to water reclamation and reuse. Topics include past and current practices of water reuse, health and environmental issues related to water reuse, water technologies and systems for water reuse, and water reuse applications. Prerequisite: CVEG 3243 or equivalent course.

CVEG 5303. Theory of Stability. 3 Hours. Study of structural members subjected to compression. Analysis of compression members considering support conditions and within frame configurations. Analysis of beams considering lateral torsional buckling. AISC Steel Manual strength equations related to columns and beams are derived and discussed. Prerequisite: Graduate standing.

CVEG 5313. Matrix Analysis of Structures. 3 Hours. Energy and digital computer techniques of structural analysis as applied to conventional forms, space trusses, and frames. Prerequisite: CVEG 3304 with a grade of C or better.

CVEG 5323. Structural Dynamics. 3 Hours. Dynamics response of single and multidegree of freedom systems. Modal analysis. Response spectra. Computer programs for dynamic analysis. Design considerations for structures subjected to time-varying forces including earthquake, wind, and blast loads. Prerequisite: CVEG 3303 with a grade of C or better.

CVEG 5333. Concrete Materials. 3 Hours. Topics include portland cement production, supplementary cementing materials, fresh and hardened concrete properties, mixture proportioning, chemical admixtures, curing, and specialty concretes. Corequisite: Lab component. Prerequisite: CVEG 4303 with a grade of C or better.

CVEG 5343. Highway Bridges. 3 Hours. Economics of spans, current design and construction specifications, comparative designs. Possible refinements in design techniques and improved utilization of materials. Prerequisite: CVEG 4313 and CVEG 4303 with grades of C or better.

CVEG 5353. Prestressed Concrete Design. 3 Hours. Analysis and design of prestressed concrete beams. Topics include flexural analysis, prestress bond, draping and debonding, allowable stresses, shear analysis and design, camber prediction, and prestress losses. Prerequisite: CVEG 4303 with a grade of C or better.

CVEG 5363. Advanced Topics in Reinforced Concrete. 3 Hours. Analysis and design of reinforced concrete members. Topics include slender columns, one-way and two-way slab design, strut and tie design, and torsion. Prerequisite: CVEG 4303 with a grade of C or better.

CVEG 5373. Advanced Structural Steel Design. 3 Hours. Design of structural steel components using the Load and Resistance Factor Design method. Intensive treatment of simple and eccentric connections, composite construction, plate girders, and plastic analysis and design. Prerequisite: CVEG 4313 with a grade of C or better.

CVEG 5383. Finite Element Methods in Civil Engineering. 3 Hours. An understanding of the fundamentals of the finite element method and its application to structural configurations too complicated to be analyzed without computer applications. Application to other areas of civil engineering analysis and design such as soil mechanics, foundations, fluid flow, and flow through porous media. Prerequisite: Graduate standing.

CVEG 5393. Advanced Strength of Materials. 3 Hours. The course will continue from the basic material addressed in the undergraduate course and investigate in more detail stress analysis as it pertains to civil engineering type problems. Topics addressed in the course will include stress analysis (two-dimensional), constitutive relationships, solutions for two-dimensional problems, flexure, torsion, beams on elastic foundations, and energy methods. Prerequisite: CVEG 2015 or MEEG 3013 with a grade of C or better.

CVEG 5403. Advanced Reinforced Concrete II. 3 Hours. Design of circular and rectangular reinforced concrete tanks for fluid and granular loads. Prerequisite: CVEG 4303 with a grade of C or better.

CVEG 5413. Transportation and Land Development. 3 Hours. Study of interaction between land development and the transportation network. Application of planning, design, and operational techniques to manage land development impacts upon the transportation system, and to integrate land layout with transportation network layout. Prerequisite: Graduate standing.

CVEG 5423. Structural Design of Pavement Systems. 3 Hours. Introduction to the structural design of pavement systems including: survey of current design procedures; study of rigid pavement jointing and reinforcement practices; examination of the behavioral characteristics of pavement materials and of rigid and flexible pavement systems; introduction to structural analysis theories and to pavement management concepts. Prerequisite: CVEG 4433 with a grade of C or better.

CVEG 5433. Traffic Engineering. 3 Hours. A study of both the underlying theory and the use of traffic control devices (signs, traffic signals, pavement markings), and relationships to improved traffic flow and safety, driver and vehicle characteristics, geometric design, and societal concerns. Also includes methods to collect, analyze, and use traffic data. Prerequisite: CVEG 3413 with a grade of C or better or graduate standing.

CVEG 5463. Transportation Modeling. 3 Hours. The use of mathematical techniques and/or computer software to model significant transportation system attributes. May compare model results with actual measured traffic attributes, using existing data sources and/or collecting and analyzing field data. Pre- or Corequisite: Lab component. Prerequisite: Graduate standing.
CVEG 5473. Transportation System Characteristics. 3 Hours.
Introduction to traffic flow theory, including traffic stream interactions and capacity. Applications for planning, design, operations. Prerequisite: CVEG 3413 with a grade of C or better and graduate standing.

CVEG 5483. Transportation Management Systems. 3 Hours.
Six transportation management systems are explored: pavement, bridge, intermodal, public transportation, safety, and congestion. System approaches are presented. Techniques are introduced on how to optimally allocate resources. Pavement and bridge structure basics are discussed and their performance parameters are presented. Case studies are used to illustrate the interfaces among various modes of transportation. Safety and congestion problems in transportation are addressed.

CVEG 562V. Research. 1-6 Hour.
Fundamental and applied research. Prerequisite: Graduate standing.

CVEG 563V. Special Problems. 1-6 Hour.
Special problems in CVEG. Prerequisite: Graduate standing. May be repeated for up to 6 hours of degree credit.

CVEG 5863. Fundamentals of Sustainability in Civil Engineering. 3 Hours.
Qualify and quantify the economic, environmental, societal and engineering drivers behind sustainability in Civil Engineering. Justification of the feasibility and benefits of sustainability in environmental, geotechnical, structural and transportation through verbal and written communications. Students cannot receive credit for both CVEG 4863 and CVEG 5863. Prerequisite: Graduate standing or instructor consent.

CVEG 5953. Fundamentals of Fracture and Fatigue in Structures. 3 Hours.
The course will cover the concepts of linear-elastic, elastic-plastic and time-dependent Fracture Mechanics as applied to fracture in a variety of materials, structures, and operating conditions. The examples will include fracture in large components such as aircraft, bridges and pressure vessels and also in bones and in soft materials and human tissue. Prerequisite: Graduate standing in Civil, Mechanical or Biomedical Engineering or consent of the instructor. This course is cross-listed with BMEG 5953, MEEG 5953.

CVEG 600V. Master's Thesis. 1-6 Hour.
Master's Thesis. Prerequisite: Graduate standing. May be repeated for degree credit.

CVEG 700V. Doctoral Dissertation. 1-18 Hour.
Doctoral Dissertation. Prerequisite: Candidacy. May be repeated for degree credit.