The Structural Engineering graduate program at Clemson University offers Master of Science and Doctor of Philosophy degrees in Civil Engineering. The objective of the program is to provide a well-balanced education in structural analysis and design, and in theoretical and practical aspects of Civil Engineering. Through the graduate level courses offered within the Civil Engineering department, students learn classical structural mechanics and behavior of engineering materials, explore modern computational techniques, recognize the uncertainties and errors in calculations and gain hands-on experiences through laboratory/field testing to prepare for a consulting or research career path. Students are also encouraged to explore supporting and complimentary courses offered in other Civil Engineering disciplines and other departments at Clemson University.

**Structural Engineering Degree Requirements**

The plan of study should include at least three of the four structural engineering core courses: Indeterminate and Matrix Structural Analysis (CE 6010), Dynamic Analysis of Structures (CE 8060), Structural Loads and Systems (CE 6080), and Earthquake Engineering (CE 8080). The plan must also include a mixture of graduate-level structural design courses such as concrete, steel, masonry, or wood design. It is required that all masters students have taken at least two undergraduate level structural design classes (CE 4020 and CE 4060 or equivalents). For those students that are accepted for admission without having taken these two classes, they should be taken before the end of the second semester of graduate study. These classes do not count towards the hour requirements for the MSCE degree.

Requirements for the degree programs are as follows:

**Master of Science Thesis Option:** A minimum of 24 course credits (not including research and thesis credits) is required. Students may take a maximum of 12 credits of 6000 level courses, must take a minimum of 12 credits of courses at the 8000 level, and must take at least 6 credits of CEE 8910 (Research and Thesis). The thesis option is required for students with research or teaching assistantships. Upon completing the research and documenting it in a M.S. thesis, students will be required to pass a public oral defense. The student’s graduate advisory committee is selected by the student after consultation with the student’s research advisor.

**Master of Science Non-thesis Option:** Students may take a maximum of 15 credits of 6000 level courses and must take a minimum of 15 credits of courses at the 8000 level, with a minimum of 30 total credits. Students following the M.S. non-thesis track must take a 4-hour written exit exam covering structural engineering coursework during their final semester. If they do not pass the written exam on the first attempt, they may re-take the exam later in the same semester. Two attempts at passing the written exam are allowed. Rules governing the written exam are attached. The Structures Exit Exam coordinator will assign committee chairs and committee members for all MS course-work only students.

**Special Consideration for Graduate Students with Non-Engineering Bachelors degrees:** For students with non-engineering Bachelors degrees (i.e., degrees in Physics, Math, etc.) additional coursework beyond what is required for an MSCE degree may be required in order to qualify for licensure. Our MSCE program is not accredited and very few are. It is
incumbent on individual students to coordinate their course plan with state examining boards to insure eligibility for licensure at a later date. In order to provide some guidance to graduate students with this concern the following summary of NCEES (National Council of Examiners for Engineering and Surveying) regulations is provided. Each state board determines their own requirements on education but most use the education standards given below. Please note that the combination of undergraduate and graduate coursework should be evaluated against these regulations.

Applicants having engineering degrees from programs that are not accredited by the Engineering Accreditation Commission (EAC) of ABET must demonstrate the following:

A. 32 college semester credit hours of higher mathematics and basic sciences

1. Credits in mathematics must be beyond algebra and trigonometry and must emphasize mathematical concepts and principles rather than computation. Courses in differential and integral calculus are required. Additional courses may include differential equations, linear algebra, numerical analysis, probability and statistics, and advanced calculus.

2. Credits in basic sciences must include at least two courses. These courses must be in general chemistry, general calculus-based physics, or general biological sciences; the two courses may not be in the same area. Additional basic sciences courses may include earth sciences (geology, ecology), advanced biology, advanced chemistry, and advanced physics. Computer skills and/or programming courses may not be used to satisfy mathematics or basic science requirements. Basic engineering science courses or sequence of courses in this area are acceptable for credit but may not be counted twice.

B. 16 college semester credit hours in general education that complements the technical content of the curriculum

1. Examples of traditional humanities/social sciences courses in this area are philosophy, religion, history, literature, fine arts, sociology, psychology, political science, anthropology, economics (micro and macro), professional ethics, and social responsibility. Examples of other general education courses deemed acceptable include management (such as organizational behavior), accounting, written and oral communications, business, and law.

2. No more than 6 credit hours may come from courses in management, accounting, business, or law. Courses in engineering economics, engineering management, systems engineering/analysis, production, and industrial engineering/management will not be counted. Language courses in the applicant’s native language are not acceptable for credit; no more than 6 credit hours of foreign language courses are acceptable for credit. Native language courses in literature and civilization may be considered in this area. Courses that instill cultural values are acceptable, while routine exercises of personal craft are not.

C. 48 college semester credit hours of engineering science and/or engineering design courses

1. Courses in engineering science must be taught within the college/faculty of engineering and must have their roots in mathematics and basic sciences but carry knowledge further toward creative application of engineering principles. Examples of approved engineering science courses are mechanics, thermodynamics, heat transfer, electrical and electronic circuits, materials science, transport phenomena, engineering economics, and computer science (other than computer programming skills).
2. Courses in engineering design must stress the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation. Graduate-level engineering courses may be included to fulfill curricular requirements in this area.

PhD Program: There are two options for entering the PhD program: directly after completing BS degree and after completing an MS degree. Following are course and reporting requirements for each:

- Direct from BS Program – 60 credits beyond the BS degree with a minimum of 30 credit hours of coursework. Also, at least 18 research credits are required.
- Post MS Program - 30 credits beyond the MS degree with a minimum of 12 credits of coursework. Also, at least 18 research credits are required.
- For both programs GS2A (Committee make-up) and GS2B (Plan of Study) forms should be completed by the end of the first year of study.

Each PhD student is required to pass the following exams during their program of study: a Preliminary examination, a Comprehensive examination (also referred to as the “proposal defense”), and a Dissertation Defense examination.

The Preliminary exam is a written exam that must be passed by the end of the third semester of study and is required for all PhD students starting Fall 2015 or later. The exam is given twice per academic year (December & April). The exam in content and format is the same as the MS written exam for the MS non-thesis option as described later in this document; however, the student’s primary advisor may substitute questions relevant to the student’s research in place of the design questions. Students must take the Required Analysis and Core Subjects sections of the exam. The Qualifying exam may be taken at the end of the second or third semesters of study, and if the first attempt is failed then a second attempt is allowed. However, a student may elect to wait and take the exam only once, at the end of the third semester of study. Students who do not pass the preliminary exam by the end of the third semester (whether having one or two attempts) will not be allowed to continue in the PhD program. Students passing the non-thesis exit exam within 24 months of entering the Structural Engineering PhD program will not need to re-take it.

The Comprehensive Exam consists of an oral defense of the student’s proposed research plan, and written questions provided by the graduate committee members. Two weeks prior to the comprehensive exam the student must submit a written research proposal to the graduate committee. Graduate School rules should be followed for the timing of this exam. After successfully completing the Comprehensive exam the student is admitted to PhD candidacy.

The Dissertation Defense exam consists of an oral defense of the PhD Dissertation. Two weeks prior to the exam the student must submit their dissertation to the graduate committee. Graduate School rules should be followed for the timing of Defense of Dissertation exam. In the rare circumstance that a student fails the exam, a second opportunity to pass the exam will be given no later than two academic semesters after the first attempt. Students that do not pass on the second attempt will not be allowed to continue in the PhD program.

Other General Information:

If a student fails to make satisfactory progress toward their degree (MS or PhD) then
permission may be denied to continue the program. Students whose cumulative GPA falls below 3.0 are placed on probation and become ineligible for assistantships.

Duties of students receiving assistantships are described in the letter giving the offer of aid and in the contract signed by the student and by the supervising faculty member.

Master's theses and PhD dissertations are submitted to the university electronically. Instructions are given on the Electronic Thesis and Dissertation (ETD) homepage located at http://scholar.lib.vt.edu/theses. Workshops on ETD are given by the Graduate School.

During the academic year, students who have a fellowship, scholarship, or graduate assistantship (GA), including teaching and research assistantships, must take a minimum of 9 credits hours per semester. Unfunded students have no minimum credit hour requirement. Audited courses are not counted toward the minimum. Graduate students are not required to enroll during summer sessions unless they are taking courses (e.g., students working on research during the summer are not required to sign up for CEE 5994 or 7994). Students working as teaching or grading assistants during the summer must register for a minimum of 3 credit hours; these hours can be coursework or research.

Students registered for 12 or more credits may audit one course; students registered for 9-11 credits may audit two courses. Students wishing to audit courses must receive permission from the course instructor.
The Glenn Department of Civil Engineering  
Clemson University  

Structural Engineering M.S.C.E. (Coursework only) Exit Examination  
Written Component  
3 April 2015  
301 Lowry  
12 am - 5 pm*  

*Students will be allowed to up to 4 hours to work the exam during the allotted time period.

The Exam consists of questions in three sections, which are further subdivided into 10 sub-topic areas. You must answer a total of 5 questions. Below you will find a list of the sections. The faculty names indicate who wrote the particular question. Place your initials next to the questions you wish to have graded.

You may bring the following resources to the exam:
- ACI 318 code
- AISC Steel Design Manual
- ACI 530 (Masonry Code)
- NDS
- ASCE 7
- One 8.5” x 11” equation sheet for structural dynamics (submit your sheet with your exam)

Place your solution sheets for each problem immediately after the problem. Place all other sheets (scrap sheets, blank sheets, etc.) at the very back of the provided notebook. Good luck!

<table>
<thead>
<tr>
<th>Sections</th>
<th>Initials</th>
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</thead>
<tbody>
<tr>
<td>I. Determinate Structural Analysis</td>
<td>Csernak</td>
</tr>
<tr>
<td>Required (10%)</td>
<td></td>
</tr>
<tr>
<td>II. Core Subjects Work any 2 (25% for each)</td>
<td>Nielson</td>
</tr>
<tr>
<td>Indeterminate/Matrix Structural Analysis</td>
<td>Nielson</td>
</tr>
<tr>
<td>Systems and Loads</td>
<td></td>
</tr>
<tr>
<td>Structural Dynamics</td>
<td>Pang</td>
</tr>
<tr>
<td>III. Structural Design Work any 2 (20% for each)</td>
<td>Cousins</td>
</tr>
<tr>
<td>Masonry</td>
<td></td>
</tr>
<tr>
<td>Prestressed Concrete</td>
<td>Ross</td>
</tr>
<tr>
<td>Structural Steel</td>
<td>Csernak</td>
</tr>
<tr>
<td>Reinforced Concrete</td>
<td>Cousins</td>
</tr>
<tr>
<td>Timber</td>
<td>Pang</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Pang</td>
</tr>
</tbody>
</table>

Honor Code Pledge: I have not given or received unauthorized assistance on this exam.
# STRUCTURAL ENGINEERING PROGRAM Course Offerings

## Tentative Graduate Courses

### Fall 2017

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 4010/6010</td>
<td>Matrix Structural Analysis</td>
<td>Nielson</td>
</tr>
<tr>
<td>CE 8930</td>
<td>Bridge Design</td>
<td>Ross</td>
</tr>
<tr>
<td>CE 8930</td>
<td>Risk Assessment</td>
<td>Pang</td>
</tr>
</tbody>
</table>

### Spring 2018

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CE 4070/6070</td>
<td>Wood Design</td>
<td>Pang</td>
</tr>
<tr>
<td>CE 4080/6080</td>
<td>Structural Loads and System</td>
<td>Nielson</td>
</tr>
<tr>
<td>CE 8030</td>
<td>Advanced Steel Design</td>
<td>TBD</td>
</tr>
<tr>
<td>CE 8040</td>
<td>Prestressed Concrete</td>
<td>Ross</td>
</tr>
<tr>
<td>CE 8080</td>
<td>Earthquake Engineering</td>
<td>Pang</td>
</tr>
</tbody>
</table>

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<tr>
<td>CE 4010/6010</td>
<td>Matrix Structural Analysis</td>
<td>TBD</td>
</tr>
<tr>
<td>CE 4040/6040</td>
<td>Masonry Structural Design</td>
<td>Redmond</td>
</tr>
<tr>
<td>CE 8020</td>
<td>Adv Reinforced Concrete</td>
<td>Cousins</td>
</tr>
<tr>
<td>CE 8930</td>
<td>Structural Dynamics</td>
<td>Pang</td>
</tr>
</tbody>
</table>

### Spring 2019

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</tr>
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<td>Bridge Design</td>
<td>Ross</td>
</tr>
<tr>
<td>CE 8080</td>
<td>Earthquake Engineering</td>
<td>Pang</td>
</tr>
</tbody>
</table>
Various courses that may be of interest to graduate students in structures, but may not be taught by structural engineering faculty

Civil Engineering
CE 6570  Material Testing and Inspection
CE 8010  Finite Element Analysis
CE 8260  Properties of Portland Cement Concrete
CE 8270  Special Cements and Concrete
CE 8280  Repair and Rehabilitation of Concrete Structures
CE 8210  Geotechnical Engineering Design
CE 8240  Earth Slopes and Retaining Structures
CE 8220  Foundation Engineering
CE 8250  Soil Dynamics and Geotechnical Earthquake Engineering
CE 8510  Reliability

Mathematics
MTHS 6000  Theory of Probability
MTHS 6030  Introduction to Statistical Theory
MTHS 6050  Statistical Theory and Methods II
MTHS 6060  Sampling Theory and Methods
MTHS 8000  Probability

Mechanical Engineering
ME 6300  Mechanics of Composite Materials
ME 6320  Advanced Strength of Materials
ME 8340  Principles of Structural Stability
ME 8360  Fracture Mechanics
ME 8370  Theory of Elasticity I
ME 8380  Theory of Elasticity II
ME 8450  Structural Vibrations

Statistics
EXST 8010  Statistical Methods I
EXST 8020  Statistical Methods II
EXST 8030  Regression and Least Squares Analysis

Related Course Programs
Students in the Master's degree program are encouraged to take courses outside of
the structures program to broaden their background. Many alternatives are available,
especially in the engineering science and mechanics, construction, geotechnical, materials,
mathematics, statistics, and computer science areas. At the PhD level it is desirable for the
student to develop additional depth in structural mechanics, mathematics, and continuum
mechanics.
Structural Engineering Faculty

Tommy Cousins, Professor; P.E., Ph.D., North Carolina State University. Bridge engineering behavior; prestressed and reinforced concrete.

Steve Csernak, Senior Lecturer; P.E., M.S., Clemson University. Structural engineering, wind and seismic design.

Bryant Nielson, Professor of Practice; S.E., Ph.D., Georgia Tech. Structural reliability, Highway bridge behavior

Weichiang Pang, Associate Professor, Ph.D. Michigan Tech. Structural Reliability, earthquake engineering, wind Engineering

Laura Redmond, Assistant Professor, Ph.D. Georgia Tech, Behavior of reinforced concrete and masonry structures, Non-linear modeling of structures.

Brandon Ross, Assistant Professor, P.E., Ph.D. University of Florida. Sustainable and resilient infrastructure, prestressed concrete.

Emeritus Faculty

Subhash Anand, Ph.D., Northwestern University, Computational Mechanics, Masonry Structures.

Russell Brown, Ph.D., Rice University, Concrete and Masonry Structures, Experimental Testing.

Jack McCormac, M.S., MIT, Structural Analysis and Design.


Peter Sparks, Ph.D., University of London, Wind Engineering and Structural Performance.
Rules governing the Written exam for coursework-only M.S.:

- MS coursework-only students should notify the Structures Exit Exam Coordinator by 10/1 if intending to graduate at the end of the fall semester and by 2/1 if intending to graduate at the end of the spring semester. Those wishing to graduate during the summer will be considered a spring graduate for purposes of taking the exit exam. The exit exam will not be given during the summer.

- If you do not pass the exam on your first attempt you may take the exam again before the end of the semester. The first offering of the exit exam will be about four weeks before the last day of class and the re-take will be offered during the last week of class.

- Topics for the 10 questions on the exam are below. Please note that you are required to work five questions in the categories shown below. The five questions to be graded should be clearly marked on your exam:
  
  o Determinant Structural Analysis (required question & 10% of grade)
  o Core Courses (work any 2, each worth 25% of grade)
    - Indeterminant/Matrix Structural Analysis
    - Structural Loads and Systems
    - Structural Dynamics
  o Design Courses (work any 2, each worth 20% of grade)
    - Structural Steel Design
    - Masonry Design
    - Timber Design
    - Reinforced Concrete Design
    - Prestressed Concrete Design
    - Earthquake Engineering

- The exam will be promptly graded with a score of 80% required for passing.

- You are allowed to bring design codes into the exam. A list of needed design codes (i.e., ACI 318, ASCE-7, etc.) will be communicated to students prior to taking the exam.

- All work should be done on engineering paper, which will be supplied by the students.