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 should also include a mixture of structural design courses with at least one graduate reinforced concrete design and one graduate structural steel design course. 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.

Ph.D. 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 the student’s proposal 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 Ph.D candidacy.

The Dissertation Defense exam consists of an oral defense of the Ph.D. 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 Ph.D. program.

Other General Information:

If a student fails to make satisfactory progress toward their degree (MS or Ph.D.) 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 Ph.D. 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 periodically 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 12 credit hours per semester. Unfunded students must take a minimum of 9 credit hours per semester. 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.

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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!

Sections

I. Determinate Structural Analysis **Required** (10%)
   - _____ Csernak

II. Core Subjects **Work any 2** (25% for each)
   - Indeterminate/Matrix Structural Analysis _____ Nielson
   - Systems and Loads _____ Nielson
   - Structural Dynamics _____ Atamturktur

III. Structural Design **Work any 2** (20% for each)
   - Masonry _____ Atamturktur
   - Prestressed Concrete _____ Ross
   - Structural Steel _____ Csernak
   - Reinforced Concrete _____ Cousins
   - Timber _____ Pang
   - Earthquake _____ Pang

Honor Code Pledge: I have not given or received unauthorized assistance on this exam.

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STRUCTURAL ENGINEERING PROGRAM Course Offerings

Tentative Graduate Courses 2015-2016

Fall 2015

CE 4010/6010  Matrix Structural Anal.  Atamturktur
CE 4070/6070  Wood Design  Pang
CE 8020  Adv. Reinforced Concrete Design  Cousins
CE 8050  Adv. Structural Mechanics  Nielson
CE 8060  Dynamic Analysis of Structures  Atamturktur

Spring 2016

CE 4080/6080  Structural Loads and Systems  Nielson
CE 8090  Structural Health Monitoring  Atamturktur
CE 8890  Bridge Design  Cousins
CE 8890  Risk Assessment  Pang

Tentative Courses 2016-17

Fall 2016

CE 4010/6010  Matrix Structural Anal.  Atamturktur
CE 4040/6040  Masonry Structural Design  Atamturktur
CE 8040  Prestressed Concrete  Ross
CE 8050  Adv. Structural Mechanics  Nielson
CE 8080  Earthquake Engineering  Pang

Spring 2017

CE 4070/6070  Wood Design  Pang
CE 4080/6080  Structural Loads and Systems  Nielson
CE 8020  Advanced Reinforced Concrete Design  Cousins
CE 8030  Advanced Steel Design  Staff
CE 8060  Dynamic Analysis of Structures  Atamturktur
CE 8890  Non-Linear Analysis of Structures  Nielson
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 6210 Geotechnical Engineering Design
- CE 6240 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 Ph.D. level it is desirable for the student to develop additional depth in structural mechanics, mathematics, and continuum mechanics.
**Structural Engineering Faculty**

Sez Atamturktur, Associate Professor, Ph.D., Penn State, Structural health monitoring, damage and defect detection.

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

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 oral 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.