CE 404/604 – MASONRY STRUCTURAL DESIGN
SPRING 2013
Earle Hall 124 MWF – 9:00 – 9:55 A.M.
Professor: Dr. Sez Atamturktur *(Dr. Atam)*
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Office Hours: MF 12:30 – 2:30 P.M.

1. COURSE OBJECTIVES:

My philosophy is to inspire curiosity and to convey the thought process in solving problems that form the essence of engineering.

Specific skills you will learn in this class include:

- An ability to write and speak fluently in the nomenclature of masonry design and construction.
- An ability to identify and explain the properties, and material specifications associated with each basic component of masonry (units, mortar, grout, accessory materials).
- An ability to design structural elements for masonry buildings, including lintels, panel walls, shear walls, columns, pilasters, and retaining walls using allowable stress and strength design methods.
- An ability to carry out structural calculations for unreinforced and reinforced masonry elements listed above.
- An ability to analyze how masonry assemblages behave with respect to differential movement, water permeability, thermal properties, acoustical properties, and fire resistance.

Students can expect to acquire these abilities only if they honor all course policies, attend class regularly, complete all assigned work on time and in good faith, and meet all other course requirements and expectations.

If there is any reason why you are not enjoying learning the material presented in this course, I should be informed immediately.

2. COURSE ADMINISTRATION:

Administration:
This course will be managed on ***MyCLEmson***, and is accessible to enrolled students at https://bb.clemson.edu/. PowerPoint slides, reading assignments, handouts, announcements, and homework will be posted regularly on this site. The student is responsible for checking this site regularly and downloading/reviewing all materials in a timely manner.

Copyright Statement:
Some of the materials in this course are possibly copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated

further. They are provided in compliance with the provisions of the Teach Act. Refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy on the Clemson University website for additional information: http://www.lib.clemson.edu/copyright/

Prerequisites:
C or better in CE 301 or Instructor Approval.

Required Text:
MSJC Building Code & Specification for Masonry Structures (TMS 402/ACI 530/ASCE 5) (TMS 602/ACI 530.1/ASCE 6)

Required text can be purchased from the masonry society: http://www.masonrysociety.org/
If you purchase it in groups of four, there will be 50% discount.

Office Hours:
Students are welcomed to make use of office hours. Office hours should not be considered as condensed versions of missed lectures or as a means of verifying the homework solutions before the deadline. Additional office hours can be provided by appointment.

3. PROFESSOR'S EXPECTATIONS:

Class Participation:
Active participation is a very important part of your learning process. Active participation includes attendance, attention, preparation (reading lecture material in advance), asking questions, answering questions and participation in in-class problem-solving sessions. A student who is prepared and actively processes the class material will master CE404/604.

You will learn the material by completing assigned reading and problem sets, in addition to material presented in lectures. Examples worked in class are not sufficient for mastery of the material. You must work additional problems on your own.

All major course announcements, including date changes, will be given in lecture sessions. Students are responsible for all information administered in lecture sessions. Therefore, attendance to lecture sessions is mandatory. However, if the instructor does not arrive within the first 15 minutes of the class, students may leave.

Homework:
Homework will be assigned biweekly on Mondays (except Martin Luther King, Jr. holiday). Students will have two weeks to complete the homework. Homework will be collected only by the professor at the beginning of the Friday lecture class. No late assignments will be accepted. Homework may include paper and pencil as well as computer work. *All assumptions must be stated explicitly.* Homework that is not neat and legible may be rejected. Unclaimed work will be retained for 6 weeks after the start of the next semester and then discarded.

Working together on homework is encouraged. However, for your own sake, turn in homework that reflects your complete, *personal* understanding of the material. Any computer program developed for homework assignments must not be duplicates of other students programs. This standard is self-enforcing – your individual understanding will be reflected in the problems you work on the examinations.

Examinations:
Exam problems will be designed to assess your fundamental understanding of the course objectives. This means the examination problems will probably **NOT** resemble problems worked in class or in homework. All quizzes, midterms and the final examination will be *comprehensive*. The format of each midterm may vary. Unless otherwise specified, all examinations are closed book / notes.

If the student provides the professor with credible written evidence of a legitimate excuse, there will be one comprehensive make-up exam at the end of the semester (see make-up exam in the schedule). There will be no other make-up exam.

4. COURSE GRADING:

An optional, comprehensive fourth midterm will be provided for those who have a legitimate written reason for a make-up.

CE 404		
Homework		9%
Three Midterm Exams		54%
First Midterm	16 %	
Second Midterm	18 %	
Third Midterm	20%	
Final Examination		25%
Final Project		12%
Instructor's Evaluation		±2%

CE 604		
Homework		9%
Three Midterm Exams		48%
First Midterm	14 %	
Second Midterm	16 %	
Third Midterm	18 %	
Final Examination		25%
Final Project		12%
Class Presentation		6%
Instructor's Evaluation		±2%

A: 100-90, B: 89-80, C: 79-70, D: 69-60, F: 59-0.
This course's grades may be curved or adjusted to shift students' grades positively, but not negatively.

Positive instructor's evaluation points reflect satisfactory class participation. Every student is expected to ask at least one question to one of the four guest lecturers. Failing to do so will be considered as unsatisfactory class participation.

Any objections to the homework, exam or project grades must be submitted in **written format** with justification supported by citations from textbooks, lectures or in-class discussions within one week after each exam.

5. ACADEMIC INTEGRITY:

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

When, in the opinion of a faculty member, there is evidence that a student has committed an act of academic dishonesty, the faculty member shall make a formal written charge of academic dishonesty, including a description of the misconduct, to the Associate Dean for Curriculum in the Office of Undergraduate Studies. At the same time, the faculty member may, but is not required to, inform each involved student privately of the nature of the alleged charge.

The Honor Code: Each student must comply with the Honor Code as approved by The College of Engineering of Clemson University.

6. HINTS FOR SUCCESS IN CE 404/604:

- Do not get behind. Studying regularly and devoting the necessary time to review the class material is the key for success. Although the time required to master the material may vary depending both on the student and topic, I recommend studying 9 -12 hours a week.

- Working numerous problems is the best way to learn structural analyses and design. Show your best effort in all homework problems. However, your studies should not be limited to homework problems; you must solve additional problems on your own. Throughout the course, guidance will be given to identifying additional problems.

- There is no substitution for working together with friends. Teaching each other and asking questions are fundamental to learning. Make sure you have a study group for this class.

- Before and after a new topic is covered in class, read the material provided in the required text. Reading in advance will help you understand the lecture better; while the later reading will help you refresh your memory and see the big picture.

- Start thinking about the Final Project immediately after reading the project description.

7. TENTATIVE COURSE SCHEDULE:

The above schedule, policies and assignments in this course are subject to change in the event of extenuated circumstances.

Lecture Schedule						
Week	**Lecture**	**Day**	**Date**	**Topic**	**Focus**	**Notes / Assignments**
1	1	W	01/09/13	Syllabus Overview	*Introduction*	Classes Begin
	2	F	01/11/13	Masonry the first thousand years		
2	3	M	1/14/2013	Masonry the first thousand years	*Material Properties*	
	3	W	1/16/2013	Masonry Structural Elements and Systems		
	4	F	1/18/2013	Masonry Terminology & Materials		Homework #1 assigned
3	5	M	1/21/2013	Martin Luther King Day	*Material Properties*	
	6	W	1/23/2013	Masonry Terminology & Materials		
	7	F	1/25/2013	Guest Lecture: Cost Estimation		Byard Stevens
4	8	M	1/28/2013	Masonry Terminology & Materials	*Material Properties*	
	9	W	1/30/2013	Laboratory Tests, Section Properties & f'm		
	10	F	2/1/2013	Unreinforced Masonry		Homework #1 due
5	11	M	2/4/2013	Unreinfroced Masonry	*Allowable Stress Design*	Homework #2 assigned
	12	W	2/6/2013	Unreinfroced Masonry		
	13	F	2/8/2013	Guest Lecture: Specifications		Ronn Shank
6	14	M	2/11/2013	**Exam #1: Unreinforced Masonry**	*Allowable Stress Design*	
	15	W	2/13/2013	Reinforced Masonry: Beam and Lintels		
	16	F	2/15/2013	Reinforced Masonry: Beam and Lintels		Homework #2 due
7	17	M	2/18/2013	Reinforced Masonry: Beam and Lintels	*Allowable Stress Design*	Homework #3 assigned
	18	W	2/20/2013	Reinforced Masonry: Walls		
	19	F	2/22/2013	Guest Lecture: Jobsite Issues		Bryan Light
8	20	M	2/25/2013	Reinforced Masonry: Walls	*Allowable Stress Design*	
	21	W	2/27/2013	Reinforced Masonry: Walls		
	22	F	3/1/2013	Reinforced Masonry: Columns		Homework #3 due / Bryan Light
9	23	M	3/4/2013	Reinforced Masonry: Columns	*Allowable Stress Design*	Homework #4 assigned
	24	W	3/6/2013	Reinforced Masonry: Pilasters		
	25	F	3/8/2013	Reinforced Masonry: Pilasters		
10	26	M	3/11/2013	**Exam #2: Reinforced Masonry ASD**	*Strength Design*	
	27	W	3/13/2013	Reinforced Masonry: Beam and Lintels		
	28	F	3/15/2013	Reinforced Masonry: Beam and Lintels		Homework #4 due
11	29	M	3/18/2013	spring break		
	30	W	3/20/2013	spring break		
	31	F	3/22/2013	spring break		
12	32	M	3/25/2013	Reinforced Masonry: Beam and Lintels	*Strength Design*	Homework #5 assigned
	33	W	3/27/2013	Reinforced Masonry: Walls		
	34	F	3/29/2013	Reinforced Masonry: Walls		
13	35	M	4/1/2013	Reinforced Masonry: Walls	*Strength Design*	
	36	W	4/3/2013	Reinforced Masonry: Columns		
	37	F	4/5/2013	Reinforced Masonry: Pilasters		Homework #5 due
14	38	M	4/8/2013	**Exam #3: Reinforced Masonry Strength Design**	*Accessories and Sustainability*	Homework #6 assigned
	39	W	4/10/2013	Connectors - Student Presentation		
	40	F	4/12/2013	Structural Movements - Student Presentation		
15	41	M	4/15/2013	Laterial Load Distribution - Student Presentation	*Acoustic, Thermal Properties and Fire Resistance*	
	42	W	4/17/2013	Bearing - Student Presentation		
	43	F	4/19/2013	Seismic Detailing - Student Presentation		Homework #6 due
16	44	M	4/22/2013	Class Overview - Student Presentation	*Cost Analysis & Class Overview*	Make-up Exam
	45	W	4/24/2013	Class Overview		
	46	F	4/26/2013	Class Overview		

The above schedule, policies and assignments in this course are subject to change in the event of extenuated circumstances.

8. TERM PROJECT:

Students enrolled in CE 404 & 604 are asked to form five member groups to compete in designing a concrete masonry wall using various concrete masonry units. Students will have the option to sign up in a team of their choice. Any student not signing up with a team will be assigned to one by the instructor by January 11th 2013.

As part of this term project, student teams are asked to design, build and test a full-scale single-wythe concrete masonry wall with multiple opening(s) that add up to the 1/4th of the cross-sectional area of the wall. The students will be given guiding dimensions for the width, height, height-to-thickness ratio, reinforcement ratio and cross-sectional area of the wall. The test will involve out-of-plane testing of lightly reinforced masonry walls.

Score	Criteria
35%	Structural Performance (structural resistance to stresses imposed during in-plane testing),
20%	Fidelity of Performance Predictions to Measurements (prediction accuracy of structural load carrying capacity),
15%	Constructability (the ease with which the structure may be built),
15%	Aesthetic Concept and Craftsmanship (the visual design appeal of the built wall and quality of the craftsmanship of the team),
15%	Functional Use of Concrete Masonry Materials (how well the design utilizes the various capabilities of traditional concrete masonry units as a building material).

The student groups are eligible to earn awards for the term project. The selecting criteria for awards will be judged quantitatively according to the list of criteria given above. Judging will be done by a team of experts including (i) architecture professor, (ii) local architect, (iii) engineering professor, (iv) local civil engineer and (v) representatives from NCMA Producer Members. *The scores assigned by the judges are only to be used to determine the awards for the class and will not directly influence the instructor's grade.*

Further information and instructions will be provided about the project throughout the semester.

Award	Prize
Best Design – First Place (awarded to the entry with the highest total score across all judged criteria)	$1,500, plus up to $1,000 in reimbursed travel expenses to present the winning design at the NCMA Annual Convention, and a trophy
Best Design – Second Place	$1,000, and a plaque
Best Design – Third Place	$500, and a plaque
Best Performance	$1,000, and a plaque
Best Prediction of Performance	$1000, and a certificate

The student teams will submit their design progress in four distinct phases. Phase I entails the initial design drawing sketches with preliminary calculations of structural performance (submission due mid-February as part of Homework #2). Phase II entails the computer-aided design of the wall and revised performance predictions (submission mid-March as part of Homework #4). In Phase III, entails student team interaction with the local NCMA Producer Members and skilled masons to formulate the construction details of the designed masonry walls. Here, students will write a brief report explaining the constructability of the masonry wall (submission in the first week of April as part of Homework #5). In Phase IV, the final phase, students will build and test the physical model of the masonry wall at the structures laboratory (completion in last week of April). Judging will take place during the first week of May with results announced to participants and publicized locally by the second week of May. The above schedule for the term project is subject to change in the event of extenuated circumstances.

9. CLASS PRESENTATION:

Students enrolled in CE 604 are expected to form groups of four and prepare a 24-minute lecture (6 minutes per each student) on topics involving masonry construction. Students will have the option to sign up in a team of their choice. Any student not signing up with a team will be assigned to one by the instructor by January 11th 2013. The selection of the presentation topic must be completed by January 14th 2013.

The student presentations are scheduled for the 14-16th weeks. The student groups can select a presentation topic among the following options. Each topic can only be selected by one group.

- Masonry Accessories
- Sustainable Construction with Masonry
- Acoustic Properties of Masonry Construction
- Thermal Properties of Masonry Construction
- Fire Resistance of Masonry Construction
- Masonry Detailing

The students who form their group first will have priority in the selection of the presentation topic. The class presentation should involve power point slides or other visual aid, which will be considered in the grading. A survey will be distributed to the class regarding the student presentation, which will aid the instructor in the grading process.

The topics covered in the student presentations will be included in the final exam as bonus points.