Fall 2020

CE 333-001: Reinforced Concrete Design

Matthew Bandelt

CE 333–001: Reinforced Concrete Design

(2 credits, 3 contact hours)

Lectures: Tuesday, Thursday 7:30am – 8:50am
Online Synchronous Course Runs via WebEx

Instructor: Matthew Bandelt, Ph.D., P.E.
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Office Hours: T. 9:00-10:30am
Th. 9:00-10:30am
or by appointment

Prerequisite: CE 332 – The student must have a working knowledge of structural analysis including determinate and indeterminate beams and frame.

Recommend Texts: ACI Committee 318 (2019), *Building Code Requirements for Structural Concrete and Commentary (318-19).* Farmington Hills, MI: American Concrete Institute.

McCormac, James C, and Brown, Russel H. (2016). *Design of Reinforced Concrete*. Hoboken, NJ: Wiley; 10th Edition. ISBN-10: 1118879104.

Wight, James K. (2015). *Reinforced Concrete Mechanics and Design*. Hoboken, NJ: Prentice Hall; 7th Edition. ISBN-10: 013348596X.

ACI 318-19 can be purchased from the American Concrete Institute at a reduced rate available only to students. Please visit the website below to register as a student. Once you register, you can purchase ACI 318-19 at the ACI bookstore for a reduced rate of $99.
Registration: www.concrete.org/membership/studentmembership.aspx
Store: www.concrete.org/store.aspx

Course Description *(from NJIT's course catalog)*

Primary objectives include the following: to acquaint the student with the properties of concrete and steel and with the behavior of reinforced concrete as a structural material; also, to develop methods for the design of reinforced concrete structural members such as beams, slabs, footings, and columns. Both ultimate strength design and working stress method will be studied.

Course Objectives (General)
By the end of this course, the student will be able to:

General Design: Compare and contrast different methods used for the design of structural concrete; describe the influence of concrete materials on concrete design; explain fundamental behavior of structural concrete and principles behind select code provisions.

Flexural and Shear Behavior and Design: Explain the behavior of a reinforced concrete section at various levels of deformation; calculate the nominal bending strength of a reinforced concrete member with and without compression reinforcement; design a reinforced concrete flexural member with economy and constructability in mind; discuss how shear forces are

transferred through a reinforced concrete component; design a reinforced concrete member to resist shear forces.

Slab Behavior and Design: Describe load transfer mechanisms in one-way slabs; design a one-way slab for flexure, shear, temperature, and shrinkage requirements.

Development and Serviceability: Explain the importance of development length as it relates to reinforced concrete member behavior; perform necessary calculations to design a member's development length, bar splices, and bar cutoffs; describe cracking behavior in reinforced concrete members; calculate deflections in a reinforced concrete member.

Short Column Behavior and Design: Explain the difference between short and slender columns; identify the types of transverse reinforcement used in columns and reasons for using them; calculate the capacity of a short reinforced concrete column.

Footing Behavior and Design: Describe limit states used in design of footings; calculate the reinforcement requirements for strip and spread footings.

POLICIES & PROCEDURES

Academic Integrity: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. *Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university***.** If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu.

Communication: All communication by the Instructor will be done through Canvas. It is your responsibility to check e-mail, and the course page on Canvas regularly.

Lectures/Class: Attendance at all lecture/class periods is expected. Students are expected to participate live via WebEx with their cameras turned on, and microphones muted unless they are asking a question. During class, I will often ask you to work on a problem or brainstorm ideas and you will then be called on to provide one of more of your answers. The goal of this in-class work will be to get you started on a problem (not necessarily finish) that we will then discuss. Please be respectful to the course instructor and your classmates. You should always bring a pencil and calculator with you to class.

Online Course Delivery: Background/Theory Lectures will be pre-recorded and posted online in Canvas. You are expected to watch these videos before 7:30am on the scheduled date. Videos will be available under the "Lecture Videos" section of course modules. All videos will be available 24 hours in advance of the scheduled lecture time period. In general, these lectures will take you approximately 20 to 30 minutes to watch. These videos will consistent of the background/theory that has typically been delivered at the start of our in-person class.

During our normal class hours we will meet live (e.g., Tuesday/Thursday, 7:30am to 8:50am) to discuss Course Updates, recap the Background/Theory Lectures and work through Example Problems. You are expected to watch and participate live with your cameras on and your microphones working.

Handouts: Copies of the notes used in class will be posted on Canvas throughout the semester at least one day before lecture. It is highly recommended that you print out a set of notes to follow along with during lecture, as notes will be filled on these handouts. A "filled in" version of these notes will be posted after class.

Prerequisites: It is assumed that you have a background in structural analysis, mechanics of materials, and statics. These three areas represent the foundation of reinforced concrete behavior and design. For example, if you are asked to design a reinforced concrete member you are expected to know how to calculate the shear force, or moment under a given set of loads. You will not necessarily be given every piece of information you need to solve a problem, but enough to be able to solve it with some looking up of expressions or conducting analyses.

Homework: Homework will be assigned to encourage further reading, to extend the material presented in lectures, and to provide practice in arriving at engineering solutions to problems. Completion of the homework is an essential part of the learning process. All homework is to be turned in individually unless specified otherwise on the assignment. If you collaborate with a classmates be sure to state that collaboration and their names at the top of your assignment.

Homework Format: It is expected that all homework be presented in an organized manner; use green, yellow or white engineering paper, one side of each page (clear side, not grid side); begin each problem on a new page and number all pages; staple all homework pages together and have your name written clearly on the front page. An example of an acceptable homework solution is available on Canvas.

Late Homework: Homework will be due at the beginning of class on the date it is due. Late Homework will be accepted up to three days after the due date with a 10% reduction for each day that it is late. After seventy-two hours, submissions will not be accepted.

Homework Solutions: Homework solutions will be posted three days after the homework is due. It is your responsibility to make sure you understand how to solve the problems by attending office hours with the instructor and/or asking questions in class. As with many engineering problems, many solutions may be possible and will be accepted if they follow logical engineering judgement.

Homework Grading: All homework should be submitted electronically by students using Gradescope. It is your responsibility to scan your assignment (or take a high quality image of it) and upload it to the Gradescope website before 7:30:00 AM on the day that it is due. Homework submissions received after 7:30:00 AM will be marked as late.

Homework questions will be graded in terms of a nine-point scheme based on three categories of format, concept, and execution. All homework questions will be equally weighted in determining your final homework grade.

Format

One (1) point will be awarded if the solution is formatted with a problem statement and a statement on what is required in the solution

One (1) additional point will be awarded if the engineering solution is presented in an organized and neat fashion that is easy to follow along.

One (1) additional point will be awarded if the solution is completed with a boxed-in answer, including a properly formatted drawing if it is requested in the problem statement.

Concept

One (1) point will be awarded if the solution has major errors in the conceptual basis of the solution.

Two (2) points will be awarded if the solution has minor errors in the conceptual basis of the solution.

Three (3) points will be awarded if the solution has no errors in the conceptual basis of the solution.

Execution

One (1) point will be awarded if the solution has two or more math or execution errors.

Two (2) points will be awarded if the solution has one math or execution error.

Three (3) points will be awarded if the solution has zero math or execution errors.

If you believe that an error was made in grading the homework, you should write a short justification of your claim and submit it via Gradescope. Your homework will be reviewed to address your concern. The deadline for submitting a re-grade request is one week after the homework is returned.

Quizzes: There will be ten unannounced quizzes given throughout the term. These quizzes will be unannounced, and based on homework submissions, in-class exercises, and recent lecture material. Your eight (8) highest quiz grades will make up your quiz grade in the calculation of your course grade.

Quizzes will be announced during class time and students will be given fifteen minutes to complete the quiz. Quizzes will be given online and consist of multiple choice questions that are each worth one point. Quizzes will be posted on Canvas/Gradescope and an e-mail announcement will be made when the quiz is available.

Exams: There will one mid-term examination and a cumulative final exam. Exams will be administered through the Respondus Lockdown Browser application.

Calculation of Course Grade: A weighted average grade will be calculated as follows:

Homework	20%
Quizzes	15%
Mid-term Exam	25%
Final Exam	30%
Project	10%

The minimum requirements for final letter grades are as follows:

A = 90.0%, B+ = 85.0%, B = 80.0%, C+ = 75.0%, C = 70.0%, D = 65.0%, F < 65.0%

Note: Grades are not curved. It is theoretically possible for everyone in the class to get an A (or an F). Your performance depends only on how you do and how much you learn, not on how everyone else in the class does. It is therefore in your best interest to help your classmates, while acting within the bounds of the stated academic integrity policy (i.e., NJIT's Code of Academic Integrity).

Instructor Commitment: You can expect the Instructor to be courteous, punctual, organized, and prepared for lecture and other class activities; to answer questions clearly; to be available during office hours or to notify you beforehand if he is unable to keep them; to provide a suitable guest lecturer or pre-recorded lecture when they are traveling; and to grade uniformly and consistently.

Students with Documented Disabilities: NJIT is committed to providing students with documented disabilities equal access to programs and activities. If you have, or believe that you may have, a physical, medical, psychological, or learning disability that may require

accommodations, please contact the Coordinator of Student Disability Services located in the Center for Counseling and Psychological Services, in Campbell Hall, Room 205, (973) 596-3414. Further information on disability services related to the self-identification, documentation and accommodation processes can be found on the webpage at: (http://www.njit.edu/counseling/services/disabilities.php)

Legal Disclaimer: Students' ability to meet outcomes listed may vary, regardless of grade. They are capable of achieving all outcomes if they attend class regularly, complete all assignments with a high degree of accuracy, and participate regularly in class discussions. This syllabus is subject to change at the discretion of the instructor throughout the term.

CEE Mission, Program Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Program Educational Objectives

Our program educational objectives are reflected in the achievements of our recent alumni.

1. *Engineering Practice:* Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
2. *Professional Growth:* Alumni will advance their technical and interpersonal skills through professional growth and development activities such a graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.
3. *Service:* Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Student Outcomes

Our BSCE student outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Course Objectives Matrix – CE 333 Reinforced Concrete Design

Strategies and Actions	Outcomes (1-7)	Prog. Object.	Assessment Methods/Metrics
Student Learning Outcome 1: Apply design methodologies, codes and specifications to the design of reinforced concrete members and elementary structures.			
Illustrate ultimate strength and allowable stress design philosophies.	1,2	1, 2	Homework, projects, quizzes, and exams.
Formulate the ultimate strength design methodology.	1,2	1	Homework, Projects, quizzes, exams.
Discuss the ACI design codes.	1,2,4	1, 2, 3	Homework, Projects, quizzes, and exams.
Student Learning Outcome 2: Apply and enhance knowledge of strength of materials and structural analysis.			
Incorporate and apply basic knowledge of strength of materials.	1,2	1	Homework, quizzes, and final exam.
Incorporate and apply basic knowledge of structural analysis.	1,2	1	Homework, quizzes, and final Exam.
Student Learning Outcome 3: Incorporate proper use of modern engineering tools for problem solving and communication.			
Introduce state of the art analysis and design software (such as Rivet/Robot, STAAD/Pro, SAP2000 etc.).	7	1, 2	Homework and projects that are solved using STAAD/Pro.
Discuss the pitfalls of computerized analysis and design and the need for sound engineering judgement.	7	1, 2	Homework and projects are solved both manually and by STAAD/Pro.
Place some assignments and course syllabus on the internet. Use e-mail for communications.	7	1	None.
Student Learning Outcome 4: Develop decision making skills and provide an environmental for independent thinking while encouraging effective teamwork.			
Demonstrate non uniqueness of design solutions.	1,2	1, 2	Design problems.
Require independent work on homework and projects, and all quizzes and exams.	1,2	1, 2	Homework, projects, quizzes, And final exam.
Require teamwork for some assignments.	5	1, 2	Homework and Projects.