



Northwestern University
Department of Civil and Environmental Engineering
Civ_Env 325 Reinforced Concrete Design¹

MWF 2-2.50 pm (Tech L160), Tu 2.30-3.50 pm (Tech LG62 discussion, Tech AG40 Lab1, Tech AG58 Labs 2 & 3)

Instructor: Arancha Alarcon, Ph.D., P.E., Tech A220
email: arancha.alarcon@northwestern.edu
ZOOM: <https://northwestern.zoom.us/j/5311890730>

Office hours: Monday and Wednesday 3-4.30 pm and by appointment

Required Textbook: *ACI 318-19 Building Code requirements for Structural concrete*. Become a student member of ACI (concrete.org), then purchase ACI 318 at student rate: <https://www.concrete.org/students/discounts.aspx>.

Suggested Textbooks: *Reinforced Concrete: Mechanics and Design*, 8th ed., J.K. Wight and J. McGregor. Pearson, Prentice Hall Inc. and ASCE7-22, *Minimum Design Loads for Buildings and other Structures*.

Catalog description: Fundamentals of reinforced concrete theory and design. Analysis and design of beams, slabs, and columns. Concurrent familiarization with current building codes, specifications, and practices.

Pre-requisite: Civ_Env 221 (Theory of Structures)

Course Objectives: By the end of the course, students should be able to:

1. Describe the theory that governs the behavior of reinforced concrete through the material properties of steel and concrete as well as the composite action of the two.
2. Design a beam for flexure.
3. Design a beam for shear.
4. Design a column for combined axial force and bending moment.
5. Compute moments of inertia of uncracked and cracked cross sections and use these values to calculate deflections.
6. Conduct simple concrete beam strength tests.
7. Present design calculations in professional manner.

Course Goals: To design fundamental components of reinforced concrete structures in compliance with ACI 318 Building Code Requirements.

Student Learning outcomes: This course addresses the following ABET student learning outcomes and civil engineering program requirements:

¹ Updated 1/5/23



Course Objectives	Program Outcomes	Criteria met via*	Assessment Outcome	Proposed Actions/comments
1	4. recognize ethical and professional responsibilities			
2-5	1. identify, formulate, and solve complex engineering problems 2. design a system, component, or process			
6	6. design and conduct experiments, as well as to analyze and interpret data 5. function effectively on a team			
7	3. communicate effectively			

This course meets the following civil engineering program requirements:

- Apply knowledge of four technical areas appropriate to civil engineering
- Design a system, component, or process in more than one civil engineering context
- Explain basic concepts in management, business, public policy, and leadership

Course Grades

- **Homework 20%**

Weekly homework due on Canvas. Solutions will be posted after due date. No late homework will be accepted. (Guidelines provided)

- **Lab reports 15%**

Three written reports on lab assignments (Rubric provided)

- **Midterm 30%**

Exam on Tuesday January 31, 2.30-3.50 pm at Tech LG62

- **Final exam 30%**

Two-hour final exam scheduled for Tuesday March 14, 3-5 pm

- **Participation and teamwork 5%**



Grade Assignment

- **A = 94-100, A- = 90-94**
- **B+ = 87-90; B = 84-87; B- = 80-84**
- **C+ = 77-80; C = 74-77; C- = 70-74**
- **D = 60-70**

Academic Integrity: Engineers are required to adhere to the highest professional responsibility and ethics. Hence, Academic Integrity is strictly enforced in this course. A grade of F may be assigned to the course if Academic Integrity is breached. Refer to the University and McCormick School policy of Academic Integrity, <http://www.mccormick.northwestern.edu/students/undergraduate/academic-integrity.html> and *Clarification of Academic Integrity* handout.

Student Support Resources: *Any student with a disability requesting accommodations is required to register with AccessibleNU Center (accessiblenu@northwestern.edu; 847-467-5530) preferably within the first two weeks of class. All discussions will remain confidential. Any student who wishes to seek assistance beyond the content of this course may want to meet with a staff member at CAPS (Student Affairs <http://www.northwestern.edu/counseling/>)*



CIV_ENV 325: Course Outline

Week	Lecture Topics & Labs	Readings-Wight & McGregor
1 1/3, 1/4 & 1/6	Course overview; Intro to Concrete; Design Process, Limit States, Loads	Chapters 1-2
2 1/9, 1/11 & 1/13	Material Properties; Beams: Flexural Behavior	Ch 3 & 4.1-4.8
3 1/16, 1/18 & 1/20	Beams: Flexural Behavior	No class on MLK day Ch 5.1, 5.3-5.4
4 1/23, 1/25 & 1/27	Beams: Flexural Behavior. Prestressed Concrete	
5 1/30, 2/1 & 2/3	Beams: Shear Behavior	Midterm (1/31) Ch 6.1-6.5
6 2/6, 2/8 & 2/10	Beams: Shear Behavior	Ch 6.1-6.5
7 2/13, 2/15 & 2/17	Beams: Steel - Concrete Bond Behavior, Development Length. Deflections	Ch 8.1-8.6 & Ch 9.1-9.5
8 2/20, 2/22 & 2/24	Columns, combined axial and flexure	Ch 11, Ch 12.1-12.2
9 2/27, 3/1 & 3/3	Columns, combined axial and flexure	Ch 11, Ch 12.1-12.2
10 3/6, 3/8 & 3/10	Floor systems, Foundations	Ch 15.1-15.5

WEEK 2: 1/10/23 LAB #1 Reinforced Concrete Conceptual Lab
WEEK 3: 1/17/23 LAB #2 Reinforced Concrete Mixing and casting
WEEK 7: 2/14/23 LAB #3 Reinforced Concrete Testing

When there is no test or lab, at least 50 min of Tuesday's meeting is used for discussion/review unless communicated otherwise.

Final exam: Tuesday March 14, 3-5 pm

