Mercer County Community College

Arts and Communication Division

ABT 220

REINFORCED CONCRETE STRUCTURES

COURSE DESCRIPTION

Design of elementary reinforced concrete structural members will be studied using basic formulas developed through the application of the underlying principles. Working and detail drawings based on design calculations of beams, columns, slabs and footings will be produced by the student in accordance with current practice and codes.

Text (s): **Reference Division Booklist**

Prerequisites: **DRA217, Structural Steel Design and Drafting**

Co-requisites:

Credits: **3** Lecture Hours: **2** Studio/Lab Hours: **3**

Food and Drink are Strictly Prohibited in Classrooms as per Health and Safety Laws. Students may not bring in chemicals of any kind without the Appropriate MSD sheets.

Course Coordinator: John Santosuosso **Latest Review: Spring 2005**

I. GENERAL OBJECTIVES

1. To understand the composition and properties of concrete.
2. To become familiar with the proportioning, mixing and testing of concrete.
3. To become familiar with the use of the "Building Code Requirements for Reinforced Concrete, ACI 318-89.
4. To become familiar with the "Working Stress" (Alternate Design Method) and/or "Ultimate Strength" (Strength Design Method) methods of analysis and design of reinforced concrete beams and columns.
5. To understand the principles of analysis and design of footings.
6. To understand the use of reinforcing steel in various reinforced concrete building members.
7. To become familiar with reinforced concrete drafting, construction and inspection techniques.

II. SPECIFIC OBJECTIVES

UNIT I - Concrete Mixtures; Reinforced Concrete Beams (Alternate Design Method)

Time: 3 1/2 Weeks

The student should be able to:

1. List and describe the components of a concrete mixture.
2. List and describe the requirements of a quality concrete.
3. List and describe the types of Portland cement.
4. Describe, using a flowchart, the manufacture of Portland cement.
5. List the approximate percentages by volume of each component of an air-entrained or non air-entrained concrete mixture.
6. Define air-entrained concrete and state the reasons for its use.
7. Define the term "admixture" and describe reasons for its use.
8. Discuss the principal factors influencing the strength of concrete.
9. Define "slump".
10. Describe in detail the procedure for making a slump test.
11. List the advantages for curing of concrete and describe several methods used.
12. Using the absolute volume method, calculate the proportions of each component (by weight) to prepare a cubic yard of concrete, given the ratio of cement, water, fine aggregate and coarse aggregate.
13. Analyze a reinforced concrete rectangular beam for tensile stress, allowable moment and/or allowable loads using the "Alternate Design Method".
14. Define "over-reinforced", "under-reinforced" or "balanced" as it applies to the analysis of a reinforced concrete rectangular beam.

UNIT II - Reinforced Concrete Beams

Time: 4 Weeks

The student should be able to:

1. Calculate concrete cover and bar spacing for reinforced concrete beams.
2. Design a reinforced concrete beam with tensile steel using the "Alternate Design Method".
3. Analyze a reinforced concrete rectangular beam for tensile steel stress, concrete compressive stress, allowable ultimate moment and/or allowable ultimate load using the Strength Design Method.
4. Calculate the allowable and actual ultimate shear stress for a beam, and determine if web reinforcement is needed, using the Strength Design Method.
5. Design vertical U-shaped stirrups for a rectangular reinforced concrete beam using the Strength Design Method.
6. Calculate basic developmental length (l_d) of reinforcing bars for given conditions.
7. Calculate the lapped length for various splice classes in tension.
8. Solve the appropriate equations for controlling cracking resulting from deflection.

UNIT III - Reinforced Concrete Columns (Strength Design Method)

The student should be able to:

1. Describe and sketch five types of concrete columns.
2. Distinguish between "tied", "spirally reinforced", "combination" and "composite" columns, and "pipe columns filled with concrete".
3. Analyze and design tied reinforced concrete columns with concentric axial loads.
4. Analyze and design spirally reinforced concrete columns with concentric axial loads.
5. Calculate the allowable load on a short tied column using the interaction diagram.
6. Design spirals and ties.
7. Calculate the allowable load on a short spirally reinforced column using the interaction diagram.
8. Calculate and use the appropriate strength reduction factors for "long" reinforced concrete columns.

UNIT IV- Footings and Retaining Walls

Time: 3 1/2 Weeks

The student will should be able to:

1. List and describe the several types of footings.
2. List the methods of failure of footings.
3. Analyze plain spread, wall, square spread and rectangular footings for soil bearing pressure, moment, shear, concrete bearings, load transfer and reinforcement developmental length.

III. METHOD OF PRESENTATION

The lecture/discussion approach is used with transparencies and handouts presented for more complicated problems and formula derivations. Class participation is emphasized by asking the students questions and encouraging discussion.

Practical examples encountered in everyday construction involving both structures in general, and specific concrete structures are introduced in the lecture. The building code requirements as published by the American Concrete Institute (ACI 318-89) are adhered to. The textbook and handouts are used for homework assignments. Students will observe the mixing, capping and testing of concrete cylinders during some of the laboratory sessions.

IV. LABORATORY

Students are expected to design the beams for a reinforced concrete floor system and several columns for the lower stories. Using AUTOCAD Software the students will then prepare a structural drawing of the floor system.

V. EVALUATION

3 Tests	45%
Final Exam	20% - 25%
Homework, Participation, Interest	10%
Projects	20% - 25%