CVLE-413: Reinforced Concrete Design

Coordinator: Wael Zatar
Spring 2006

Credit: 3 hours
Tuesday &Thursday 2.00 ~ 4.20 p.m.
Gullickson Hall, Room GH-5

Catalog Data:

CVLE-413 Reinforced Concrete Design (2-3) Credit 3 Theory of Reinforced Concrete design using ACI 318 working stress and ultimate strength methods; design of beams, one way slabs, and columns using ultimate strength design; and developments lengths and splices.

Textbooks:

- *Design of Reinforced Concrete*, 7th edition, McCormac, J. C., Nelson, J.K., Sixth Edition, John Wiley and Sons, Inc., 2006.
- *Building Code Requirements for Reinforced Concrete (ACI 318-05) and Commentary (ACI 318R-05),* American Concrete Institute, 2005.

References:

- *Design of Concrete Structures*, Nilson, A. H., Darwin, D., and Dolan, C. W., Thirteenth Edition, McGraw Hill (2004).
- *Structural Concrete - Theory and Design*, 3rd Edition, Hassoun, M. N., and Al-Manaseer, A., John Wiley, 2005.
- *Reinforced Concrete – A Fundamental Approach*, Edward G. Nawy, 5th Edition, Prentice Hall, 2005.
- *Reinforced Concrete, Mechanics & Design,* 4th Edition, MacGregor, J. G., Wight, J.K., Prentice Hall, 2005.
- *Reinforced Concrete Design*, 3rd edition; Kenneth Leet, McGraw Hill, 1997.
- *Simplified Design – Reinforced concrete Buildings of Moderate Size and Height,* 2nd Edition, Portland Cement Association, 1993.
- *Standard Handbook for Civil Engineers*, Ricketts, J.T., Loftin, M.K., and Merritt, F.S., Fifth Edition, McGraw Hill (2004).
- Class Handouts.

Office Hours:

Tuesday 11.00 a.m. ~ 12.00
Thursday 1.00 p.m. ~ 4.30 p.m (at the lab in Bldg. 701, Charleston).

For those of you who will not be able to meet the instructor during the assigned

office hours, the instructor has an open door policy, which means that you are welcome to come and ask him by appointment or at any appropriate time.

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Objective:

- To have students learn behavior and design of reinforced concrete members and structures, enough to be immediately useful in design of reinforced concrete beams, walls, slabs, and columns using ACI-318. Both the working stress and the ultimate strength design methods will be covered.
- To correctly answer all reinforced concrete questions on the structural engineer and *EIT/PE* exams.
- In addition, to prepare students for lifetime learning as reinforced concrete design evolves, and to form a foundation for possible graduate study in the subject.

Outcomes:

With the successful completion of the course, the student should be able to:

- Understand the working stress and ultimate strength design methodologies
- Analyze and design singly reinforced concrete beams using both the working stress and ultimate strength methods
- Analyze and design reinforced concrete T-beams
- Analyze and design doubly reinforced beams
- Analyze and design one-way reinforced concrete slabs and walls
- Determine deflections of reinforced concrete beams
- Determine development lengths of straight bars in tension and compression
- Determine development lengths of hooks
- Design for shear strength of beams
- Analyze and design axially loaded short reinforced concrete columns
- Analyze and design eccentrically loaded short reinforced concrete columns
- Analyze and design short reinforced concrete columns subjected to bi-axial bending
- Analyze and design slender reinforced concrete columns
- Understand the applicability of strut and tie models for disturbed regions
- Learn the art of detailing different reinforced concrete elements

Prerequisites by Topic:

- Structural Analysis

Topics:

- Material properties of concrete: steel, cement, water, aggregates, and admixtures.
- Steel versus concrete.
- Design philosophies - working stress design, ultimate strength design, serviceability limit states, safety factors, loads.
- Ultimate strength design of singly reinforced beams
- Ultimate strength design of T-beams
- Ultimate strength design of doubly reinforced beams
- Ultimate strength design of one way slab
- Ultimate strength design of walls
- Shear and diagonal tension
- Deflection and cracking
- Development lengths
- Axially loaded columns
- Eccentrically loaded columns
- Bi-axial bending of columns
- Slender columns
- Detailing of longitudinal and transverse reinforcement.
- Design of retaining and foundation walls.
- Design using strut and tie models
- Introduction to prestressed concrete.

The coordinator may slightly change the lecture topics in order to achieve the maximum benefit of course learning outcomes.

Contribution to Program Outcomes:

1. an ability to apply knowledge of mathematics, science, and engineering

3. an ability to design CE projects

5. an ability to identify, formulate, and solve CE problems

9a. a recognition of the need to engage in life-long learning

9b. an ability to engage in life long learning

11 an ability to use techniques, skills, and modern engineering tools necessary for engineering practice

12. an ability to apply sound safety practices in laboratory and design work

Course Relevance & Contribution to Professional Component of Program Curriculum:

- Reinforced concrete is one of the major building materials presently in use all over the world. It appears likely to remain so for the foreseeable future. Course emphasis on material and member behavior related to characteristics should enable students to remain current with design paradigms as these change with the introduction of modified and new constituents.

- The course utilizes the most recent ACI design code (required text) that is used in professional practice. The entire course is devoted to component design as outlined in the topic descriptions

Computer Usage:

Excel Spreadsheets
Structural analysis programs
AutoCAD Software
The World Wide Web
Power Point Software
Electronic mail for effective communication between professor and students
Research in library resources for references

Accreditation Category Content:

Engineering Science:	0.0 credits	(0.0%)
Engineering Design :	3.0 credits	(100.0%)

Lab Sessions:

During the laboratory portion of the course, the coordinator works additional problems. Students may be required to practice on solving other problems, during which the coordinator will be there to answer questions.

Homework Assignments:

Homework assignments will be made throughout the semester. All homework must be submitted at the start of class on the assignment date. Late homework is not acceptable except for unusual circumstances, e.g., an excused absence. Checking of your e-mail daily is required on a daily-basis for any additional information.

Exams:

Two exams and a final will be given during the course of the semester. No makeup exams will be given with the exception of unusual circumstances (severe injuries, family emergencies, etc.).

Grading Policy:

Homework Assignments	20%
Exam 1	25%
Exam 2	25%
Final Exam	30%

Letter Grade Scale:

90-100	A
80- 89	B

70-79	C
60-69	D
0-59	F

The coordinator does reserve the right to slightly change these numbers based on class groupings.

Engineering Ethics:

It will be assumed that each student subscribes to a professional code of ethics that is the basis for their behavior in class. Any and every case where these ethics are violated will be dealt with according to the provisions of the university.

Additional Information:

[1] Arrangements for inviting guest speakers from the concrete industry will be made.

[2] A field trip will be arranged to the WV EXPO Equipment Technology and Design.

[3] There will be regular homework assignments.

[4] You are expected to provide your homework in engineering papers - not a Xerox copy.

[5] Although you are expected to attend all classes, the coordinator accepts your absence for one session provided that an advance notice will be given, unless this is unavoidable.