CVLE-413: Reinforced Concrete Design

Spring 2008

Credit: 3 hours
Lecture: Tuesday & Thursday 9.30 ~ 10.45 a.m., Gullickson Hall GH5
Lab: Tuesday 2.00 ~ 4.00 p.m., Gullickson Hall GH5

Catalog Data:

CVLE-413 Reinforced Concrete Design - Theory of Reinforced Concrete design using *ACI* 318 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, ACI 318-05 Code Edition McCormac, J. C., Nelson, J.K., John Wiley and Sons, Inc., 2005.
- *Building Code Requirements for Reinforced Concrete (ACI 318-05) and Commentary (ACI 318R-05),* American Concrete Institute, 2005.

Other 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.
- *Concrete Structures – Mehdi Setareh and Robert Darvas*, Pearson, Prentice Hall, 2007.
- *Standard Handbook for Civil Engineers*, Ricketts, J.T., Loftin, M.K., and Merritt, F.S., Fifth Edition, McGraw Hill (2004).
- *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.
- Class Handouts.

Office Hours:

Monday	9.00 a.m. ~ 11.50 a.m.
Tuesday	8.30 a.m. ~ 9.30 a.m.
Thursday	8.30 a.m. ~ 9.30 a.m.

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 an appropriate time.

Contact Information: Professor: Wael Zatar
College of Information Technology and Engineering
Gullickson Hall GH3
Phone : (304) 696-6043
Fax : (304) 696-5454
E-mail : zatar@marshall.edu

Prerequisites by Topic:

- CVLE-212 Structural Analysis

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. The ultimate strength design method will be covered.
- To correctly answer 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 ultimate strength design methodology
- Analyze and design singly reinforced concrete beams
- Analyze and design doubly reinforced beams
- Analyze and design reinforced concrete T-beams
- Analyze and design one-way reinforced concrete slabs
- Design for shear strength of beams
- Analyze and design retaining walls
- Determine crack widths and deflections of reinforced concrete 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
- Determine development lengths of straight bars in tension and compression
- Determine development lengths of hooks
- Understand the applicability of strut and tie models for disturbed regions
- Learn the art of detailing different reinforced concrete elements

Topics:

- Review material properties of concrete
- 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 doubly reinforced beams
- Ultimate strength design of T-beams
- Ultimate strength design of one way slab
- Shear and diagonal tension
- Ultimate strength design of retaining walls
- Deflection and cracking
- Axially loaded columns
- Eccentrically loaded columns
- Bi-axial bending of columns
- Slender columns
- Development lengths
- Detailing of longitudinal and transverse reinforcement.
- Strut and tie models and/or Introduction to prestressed concrete (if time permits).

***** *The instructor reserves the right to slightly change the topics and their order to achieve the maximum benefit of the course learning outcomes.*

Contribution to Program Outcomes:

1. an ability to apply knowledge of mathematics, science, and engineering
3. an ability to design civil engineering projects or components of projects to meet desired needs
5. an ability to identify, formulate, and solve civil engineering 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 they 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

Assessment:

All learning outcomes will be accessed through questions in class and the evaluations of homework assignments, presentation, and examination problems.

Computer Usage:

Excel spreadsheets

ANSYS/CivilFEM Software for structural analysis or similar software

AutoCAD software

The World Wide Web

PowerPoint software

Electronic mail for effective communication between the 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 professor works additional problems. Students may be required to practice on solving other problems, during which the professor may be there to answer questions.

Homework Assignments:

- Homework will regularly be assigned either during the class time or by e-mail.
- Checking your e-mail is required on a daily-basis for information regarding homework assignment.
- Homework must be submitted before the starting time of class on the assignment date.
- Late homework is not acceptable except for unusual circumstances, e.g., an excused absence.
- You are expected to provide your homework in engineering papers - not a Xerox copy.
- Homework must be neat, readable, and must conform to acceptable Standards of Engineering Computation.
- The instructor will assign a presentation topic to each student. The presentations shall be prepared in a PowerPoint format. The presentations will be given on a date that will be chosen by the professor, before the final exam. An electronic file of the presentation shall be provided to the instructor before the time of the presentation. Failure to submit the electronic file will result in a partial credit for

the presentation. A hard copy of the presentation shall be submitted to the professor before the presentations' day.

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 that are consistent with Marshall University Policies.

Grading Policy:

Homework Assignments	20%
Project and Presentation	15%
Attendance	5%
Exam 1	15%
Exam 2	15%
Final Exam	30%

Total	100%

The instructor will not discuss the grades in e-mails or phone calls.

Attendance:

You are expected to attend all lectures and labs. However, the instructor accepts your absence for one session provided that an advance notice will be given; unless this is unavoidable. Non-excused absence for few lecture/lab sessions may be dealt with in accordance with the attendance policy of the course and Marshall University policies.

Letter Grade Scale:

90-100	A
80- 89	B
70-79	C
60-69	D
0-59	F

The instructor does reserve the right to slightly adjust or scale the grades based on class groupings.

Engineering Ethics and Academic Honesty:

It will be assumed that each student subscribes to a professional code of ethics that is the basis for his/her behavior in class. Any and every case where the professional code of ethics and academic honesty are violated will be dealt with in accordance with the Marshall University Student Handbook and the governing provisions of Marshall University.

Additional Information:

[1] Arrangements for having a study tour will be made.