Introduction

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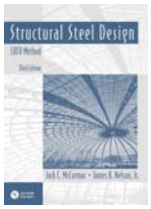
SYLLABUS, MAJOR TOPICS & COMPUTERS

A. J. Clark School of Engineering •Department of Civil and Environmental Engineering

FALL 2002



By
Dr. Ibrahim. Assakkaf

ENCE 355 - Introduction to Structural Design
Department of Civil and Environmental Engineering
University of Maryland, College Park

CONCRETE.com

Course Syllabus

- ENCE 355 – Introduction to Structural Design (3 credit)
- MWF 9:00 am – 9:50 am, EGR 2112

Course Syllabus

INSTRUCTOR:

Name:	Dr. Ibrahim A. Assakkaf
Office Hours:	MWF 10:00 am - 12:00 am and by appointment
Room:	0305, Engineering Classroom Building (EGR) Center for Technology and Systems Management (CTSM)
Telephone:	(W) 301-405-3279
Email:	assakkaf@eng.umd.edu
URL:	http://ctsm.umd.edu/assakkaf http://www.cee.umd.edu/assakkaf

Course Syllabus

TEACHING ASSISTANT:

Name:	Dr. Maged Sidki Morcos
Office Hours:	MWF 12:00 pm – 1:00 pm
Room:	TBA
Telephone:	(301) 276-1000, Rm. 253
Email:	m_sidki@hotmail.com

Course Syllabus

TEXTBOOKS:

1. "Reinforced Concrete Design," 5th Edition, Spiegel, L. and Limbrunner, G. F., 2003, Prentice Hall.
2. "Structural Steel Design," 3rd Edition, McCormac, J. and Nelson, J., Jr., 2003, Prentice Hall.
3. "Building Code Requirements for Structural Concrete (318-02) and Commentary (318-02)," American Concrete Institute (ACI).
4. "LRFD Manual of Steel Construction," 3rd Edition, American Institute for Steel Construction (AISC).

Course Syllabus

REFERENCES:

1. "Design of Concrete Structures," 12th Edition, Nilson, A. H., 1997, McGraw Hill.
2. " Steel Structures," 3rd Edition, Salmon, C., G. and Johnson, 1990, Harper and Raw.

Course Syllabus

GRADING:

Homework	20%
Exam I	25%
Exam II	25%
Final Exam	30%
Quizzes & Attendance (±).	
	100%

Course Syllabus

PREREQUISITES:

- ENCE 300
- Permission of the Department

GENERAL COURSE DESCRIPTION (UM SCHEDULE OF CLASSES, FALL 2002):

Structural design of members for buildings and bridges subjected to tensions, compression, shear and bending. Materials: structural steel and reinforced concrete. Design of welded and bolted connections. Placement of reinforcing bars in concrete members.

Course Syllabus

HOMEWORK ASSIGNMENTS:

Professional presentation of homework assignments is required. Professional presentation consists of neat and organized solution of problems on **one side of 8.5"x11" papers**. Any homework not complying with professional standards will not be graded and will be assigned zero credit. The homework assignments are due one week after they are assigned. Homework will be assigned as the material is covered and will be collected every Monday at the beginning of the lecture period, starting on Monday 9/9. Assignments turned in late will be docked 10% for each day it is late past the original due date.

Course Syllabus

HOMEWORK ASSIGNMENTS (cont'd):

Solutions will be available from the TA and on the class website after the problems are returned. No assignment will be accepted after the answers have been posted. Students are encouraged to discuss and formulate solutions to the problems by working in teams. However, assignments must be completed and submitted individually. Simply copying the answers from another student or from a solutions manual is not acceptable and will not be tolerated.

Course Syllabus

HOMEWORK ASSIGNMENTS (cont'd):

Guidelines for homework are given below:

1. Use good quality paper, such as engineering graph paper or college-ruled paper, any color, with no spiral edges
2. Write on only one side of the paper
3. Either pen or pencil is acceptable
4. Include your name, section, and page number (e.g. 1/3 means 1 of 3) on each sheet
5. Staple all pages together in the upper left corner
6. Neatly box all answers, and include appropriate units for numerical answers
7. Show all work (e.g. no work means no credit will be given)

Course Syllabus

HOMEWORK ASSIGNMENTS (cont'd):

If the above guidelines are not followed, the TA will either reject the assignment outright, for extreme cases, or deduct points for items that do not conform to the specifications.

Course Syllabus

EXAMS AND QUIZZES:

All students must take all exams and quizzes including the final exam. Only extenuating circumstances will be accepted as an excuse for missing an exam. The student must notify the instructor of the reason for absence as soon as possible. Health related excuses require **medical reports** and the **signature of a physician** that provided treatment. You are encouraged to go over Chapter 4 of the Undergraduate Catalogue for the University policies, or visit http://www.inform.umd.edu/ugradcat/chapter4/attendance.html

Course Syllabus

COURSE WEBSITE: Students are encourage to access course web site at http://www.ajconline.umd.edu to download course materials such as homework sets and solutions. Timely information will also be posted on the web site. At initial login, use your wam account name as the username, and your SID as the password. You are advised to change your password after your first login. Report any problem with the course web site to the instructor. For technical problems of the web site, contact the Instructional Technologies staffs at 0123 Martin Hall.

Course Syllabus

■ Schedule for Lectures

Week	Lec.	Date	Section	Topic	Homework		
1	1	W, 9/4	Handout	Introduction to the Course			
	2	F, 9/6	Handout	Structural Design and Analysis, Code Specifications	Handout		
2				**PART I – REINFORCED CONCRETE ANALYSIS AND DESIGN**			
				SL* Chapter 1 – Materials & Mechanics of Bending			
	3	M, 9/9	1.1 – 1.4	Concrete, ACI Building Code, Cement and Water, Aggregates	1-1		
			1.5	Concrete in Compression	1-2		
	4	W, 9/11	1.6 – 1.8	Concrete in Tension, Reinforcing Steel, and Beams	1-3	1-5	1-10
				SL* Chapter 2 – Rectangular Reinforced Concrete Beams and Slabs: Tension Steel Only			
	5	F, 9/13	2.1 – 2.2	Introduction, Methods of Analysis and Design			
			2.3 – 2.4	Behavior Under Load, Strength Design Methods Assumption			
3	6	M, 9/16	2.5 – 2-6	Flexural Strength of Rectangular Beams, Equivalent Stress	2-1a	2-2	
			2.7	Balanced, Overreinforced, and Underreinforced Beams			
			2.8	Reinforcement Ratio Limitations and Guidelines	2-5		
	7	W, 9/18	2.9	Strength Requirements			
			2.10	Rectangular Beam Analysis for Moment (Tension Only)	2-7		
			2.13	One-Way Slabs	2-11		
	8	F, 9/20	2.14 –2.16	Rectangular Beam Design for Moment (Tension Only)	2-14	2-28	

Course Syllabus

■ Schedule for Lecture (cont'd)

Week	Lec.	Date	Section	Topic	Homework	
4				**SL* Chapter 3 – Reinforced Concrete Beams: T-Beams and Doubly Reinforced Beams**		
	9	M, 9/23	3.1 – 3.2	Introduction, T-Beams Analysis	3-1	3-5
	10	W, 9/25	3.3, 3.5, 3.6	Development of T-Beam $A_{s,\max}$, T-Beam Design for moment	3-6	3-12
	11	F, 9/27	3.6 – 3.7	Summary of T-Beams Analysis and Design		
5	12	M, 9/30	3.8 – 3.11	Doubly Reinforced Beams, Doubly RB Analysis	3-16	
	13	W, 10/2	3.12 – 3.14	Doubly Reinforced Beam Design for Moment	3-22	
				SL* Chapter 4 – Shear in Beams		
	14	F, 10/4	4.1 – 4.2	Introduction, Shear Reinforcement Design Requirements	4-1	4-4
6	15	M, 10/7	4.3 – 4.4	Shear Analysis Procedure, Stirrups Design Procedure	4-5	4-12
				SL* Chapter 5 – Development, Splices, and Simple-Span Bar Cutoffs		
	16	W, 10/9	5-1 – 5.2	Development Length, Tension Bars	5-1	5-2
	17	F, 10/11	5.3 – 5.4	Development Length, Compression Bars, Standard Hooks	5-7	
7	18	M, 10/14	5.9	Simple-Span Cutoffs and Bends	5-12	
				SL* Chapter 9 – Columns		
	19	W, 10/16	9.1 –9.3	Introduction, Strength (small eccentricity), Code Requirements		
	20	F, 10/18	9.4 – 9.5	Analysis of Short Columns, Design of Small Columns	9-3	9-9

Course Syllabus

■ Schedule for Lecture (cont'd)

Week	Lec.	Date	Section	Topic	Homework
8	21	M, 10/21	9.7 – 9.11	The Load-Moment Relationship, Analysis (large eccentricity)	9-11
				PART II – STRUCTURAL STEEL ANALYSIS AND DESIGN	
				MN* Chapter 1 – Introduction to Structural Steel Design	
	22	W, 10/23	1.1 – 1.7	Advantages and Disadvantages, Early uses, Steel Sections	
			1.8 – 1.21	Modern Structural Steels, Uses, Failure, and Computers	
				MN* Chapter 2 – Specifications, Loads, and Methods of Design	
	23	F, 10/25	2.1 – 2.4	Specifications and Building Codes, Loads, Dead & Live Loads	
			2.5 – 2.6	Environmental Loads, Load & Resistance Factor Design	2-1
9	**24**	**M, 10/28**		*** **EXAM I** ***	
	25	W, 10/30	2.7 – 2.10	Load and Resistance Factors, Reliability and LRFD	2-2
			2.11 – 2.12	Advantages of LRFD, Computer Example	2-4 2-10
				MN* Chapter 3 – Analysis of Tension Members	
	26	F, 10/1	3.1 – 3.3	Introduction, Design Strength, Net Areas	3-2 3-8
10	27	M, 11/4	3.4 – 3.5	Effect of Staggered Holes, Effective Net Areas	3-10 3-14 3-20 3-24
	28	W, 11/6	3.6 – 3.7	Connecting Elements for Tension Members, Block Shear	3-27 3-30 3-34
				MN* Chapter 4 – Design of Tension Members	
	29	F, 11/8	4.1 – 4.3	Selection of Sections, Built-up Tension Members Rods and	4-3 4-23
			4.4 – 4.5	Bars Pin-connected Members, Design for Fatigue Loads	

Course Syllabus

■ Schedule for Lecture (cont'd)

Week	Lec.	Date	Section	Topic	Homework
11				**MN* Chapter 5 – Introduction to Axially Loaded Compression Members**	
	30	M, 11/11	5.1 – 5.3	General, Residual Stress, Sections Used for Columns	
	31	W, 11/13	5.4 – 5.5	Development of Column Formulas, Euler Formula	5-2 5-4
	32	F, 11/15	5.6	End Restraints and Effective Lengths of Columns	5-6 5-10
			5.7	Stiffened and Unstiffened Elements	
12	33	M, 11/18	5.8 – 5.9	Long, Short, and Intermediate Columns, Column Formulas	5-15 5-17
			5.10 – 5.11	Maximum Slenderness Ratios, Example Problems	
	34	W, 11/20		**MN* Chapter 6 – Design of Axially Loaded Compression Members**	
			6.1 – 6.4	Introduction, LRFD Design Tables, Built-up Columns	6-2 6-8
	35	F, 11/22	6.5	Built-up Columns w/ components in contact with each other	6-22
			6.7	Built-up Columns w/ components not in contact with each other	
13				**MN* Chapter 8 – Introduction to Beams**	
	36	M, 11/25	8.1 – 8.4	Types of Beams, Sections, Stresses, Plastic Hinges	8-2
	37	W, 11/27	8.5 – 8.7	Elastic Design, Plastic Modulus, Theory of Plastic Analysis	8-4 8-11
	38	**F, 11/29**		********* **NO CLASS, Thanksgiving Recess** *********	

Course Syllabus

- Schedule for Lecture (cont'd)

Week	Lec.	Date	Section	Topic	Homework		
14	39	M, 12/2	8.8 – 8.9	The Collapse Mechanism, Virtual-Work Method	8-22	8-28	
			8.10	Location of Plastic Hinge for Uniform Loading	8-31		
	40	W, 12/4	8.11 – 8.12	Continuous Beams, Building Frames	8-37		
				MN* Chapter 9 – Design of Beams for Moments			
			9.1 – 9.3	Introduction, Yielding Behavior, Design of Beams (Zone 1)	9-1	9-4	9-10
	41	**F, 12/6**		*** **EXAM II** ***			
15	42	M, 12/9	9.4 – 9.5	Lateral Support of Beams, Inelastic Buckling (Zone 2)	9-12	9-16	
			9.6	Moment Capacities			
	43	W, 12/11	9.7 – 9.9	Elastic Buckling (Zone 3), Design Charts, Noncompact Sections	9-24		
	44	F, 12/13		Review			
16		T, 12/19	All material	*** **FINAL EXAM - 8-10 AM, EGR 2112** ***			

Course Syllabus

- Course Objective
  - Introduce the concept of Design of structural members for building and bridges subjected to tensions, compression, shear and bending.
  - Materials: structural ***steel*** and reinforced ***concrete***.

Major Topics

PART I

Concrete Design and Analysis

Major Topics

- Concrete is a mixture of cement, fine and coarse aggregates, and water.
- Water is the key ingredient for chemical reaction for curing.

Add Water

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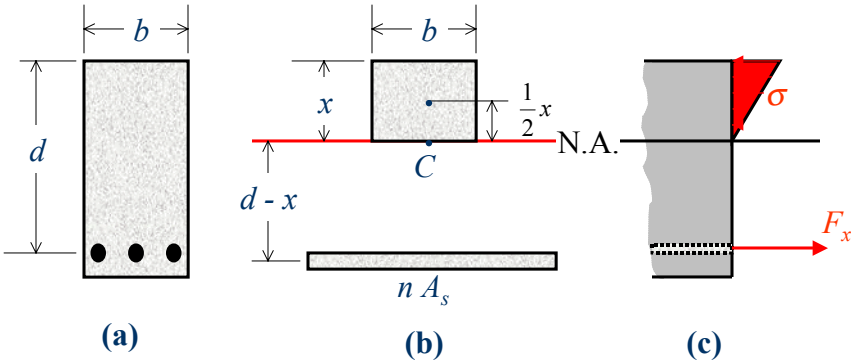
Cement + Aggregates = Concrete

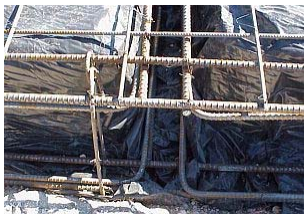
Major Topics

- Materials and Mechanics of Bending
  - Concrete Strength



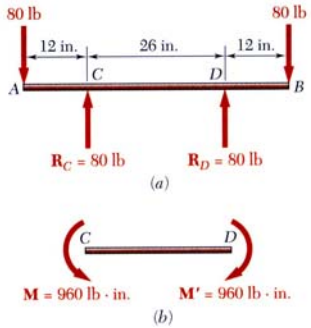
Major Topics

Reinforcing Steel



Major Topics

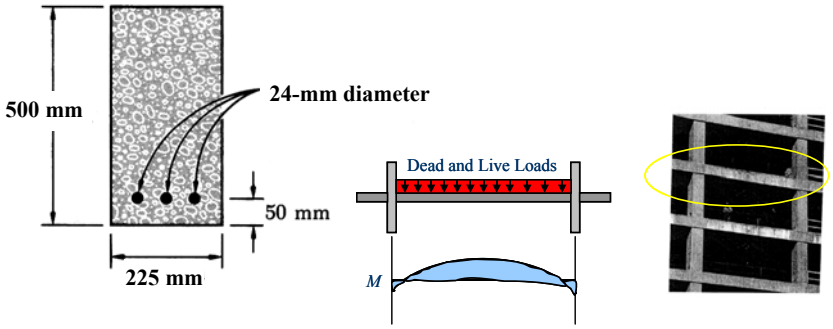
Mechanics of Bending



Pure Bending: Prismatic members subjected to equal and opposite couples acting in the same longitudinal plane

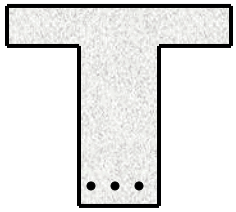
Major Topics

- RECTANGULAR R/C CONCRETE BEAMS: TENSION STEEL ONLY

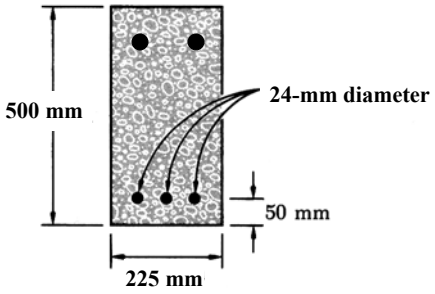


Major Topics

- Reinforced Concrete Beams: T-Beams and Doubly Reinforced Beams



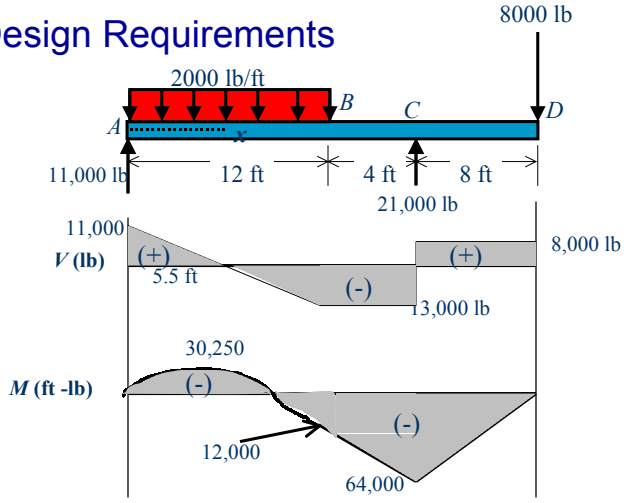
T-Beam



Doubly Reinforced

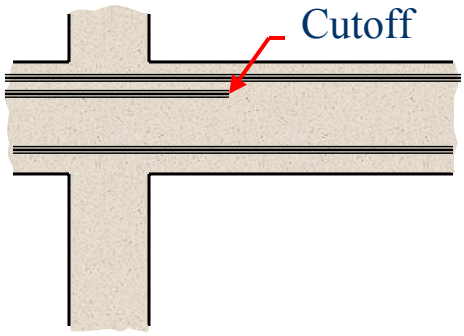
Major Topics

- Shear in Beams
  - Design Requirements



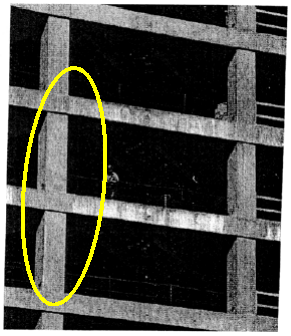
Major Topics

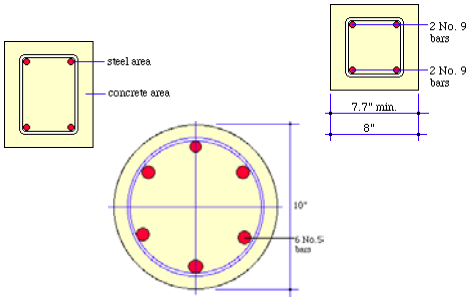
- Development Length, Splices, and Simple Span Bar Cutoffs



Major Topics

- Reinforced Concrete Columns

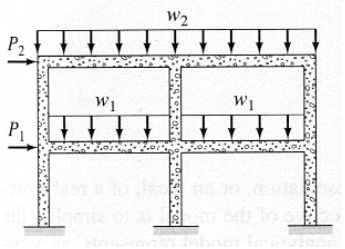


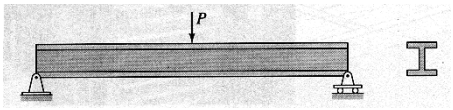


Major Topics

PART II

Steel Design and Analysis





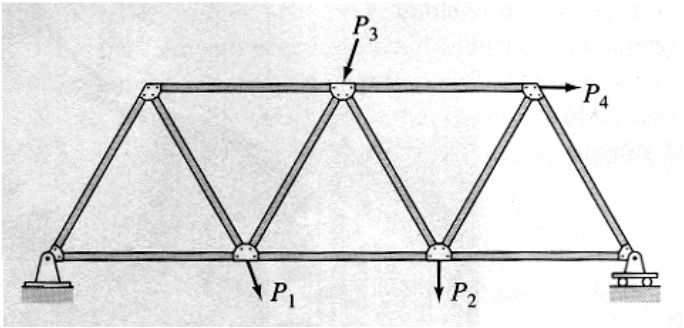
Major Topics

- Introduction to Structural Steel Design
- Specifications, Loads, and Methods of Design

ASIC American Institute of Steel Construction

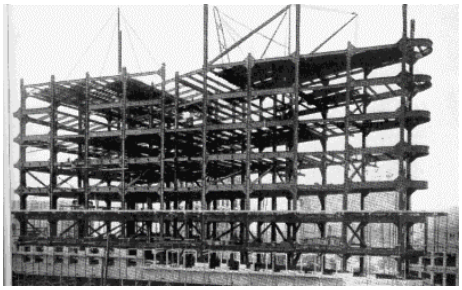
Major Topics

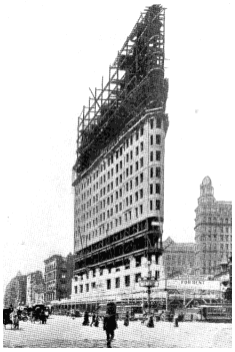
- Analysis and Design of Tension Members



Major Topics

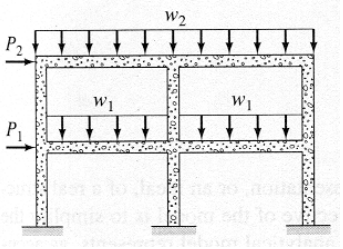
- **Introduction to the Design of Axially Loaded Compression Members**

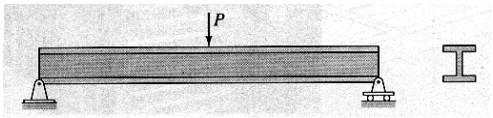




Major Topics

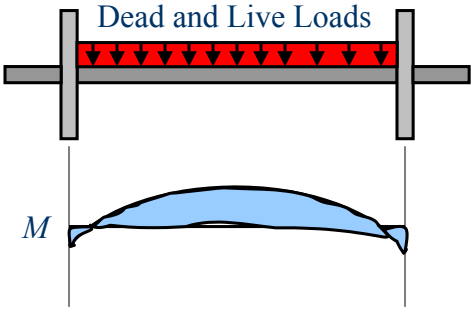
- Introduction to the Analysis and Design of Beams for Moments

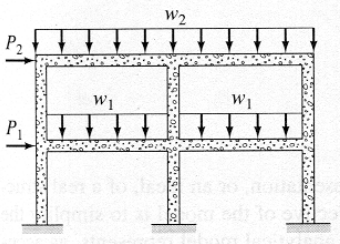




Major Topics

- Introduction to the Analysis and Design of Beams for Moments





Computers and Software

- Computers Evolution Era (Chapra & Canale 1988)
  - Zero Generation - Manual & Mechanical (pre 1951)
  - First Generation – Vacuum tubes (1951 – 1958)
  - Second Generation – Transistors (1958 – 1964)

Computers and Software

- Computers Evolution Era (Chapra & Canale 1988)
  - Third Generation – Integrated circuits (1964 – 1971)
  - Fourth Generation – Very large scale integration (1971 – present)
    - Mainframes, Supercomputers
    - Personal Computers, Microcomputers, and Minicomputers

Computers and Software

- Computers Evolution Era (Chapra & Canale 1988)
  - Fifth Generation (1990?)
    - Parallel Processing
    - Artificial intelligence

Computers and Software

- High-level Languages
  - FORTRAN (introduced by IBM in 1957)
    - FORTRAN = *FORmula TRANslation*
    - *Developed for the IBM 704 Computer*
    - *Developed by John Backus and a team of 13 other programmers*
  - BASIC
  - Pascal
  - Others

Computers and Software

- Software Packages
  - MATLAB
  - MathCad
  - Spreadsheet
    - MS Excel
    - Quattro Pro
  - Specialized Structural Packages
    - GTSTRUDLE
    - ETABS
    - SAP & INSTEP32 Design Software
    - etc

Major Topics



Be Proud To Be An Engineer