

53:086 CIVIL ENGINEERING MATERIALS
Department of Civil & Environmental Engineering
College of Engineering, The University of Iowa
Spring Semester, 2008

Instructor:

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Textbook:

Materials for Civil and Construction Engineers 2nd Ed., M.S. Mamlouk and J.P. Zaniewski, Pearson Prentice-Hall, 2006.

Lab Instructor:

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Grader:

Tim McDermott, Graduate Student
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Office hours: M 1:30-3:30pm, 1131 SC

Course Objectives:

The goal of this course is to provide a firm grasp on how to use, specify, and test common civil engineering construction materials such as: steel; aluminum; aggregates; portland cement concrete; asphalt cement concrete; constituents of masonry; fiber reinforced plastics (FRPs); and timber. While the practical behaviors of these materials systems will be emphasized, an understanding of these behaviors will be approached through examination of the materials' microstructural characteristics.

Course Grading:

% of Total Grade

Midterm Exam	15
Final Exam	25
Homework Assignments (~10)	30
Lab Performance & Reports	30
Term Project	**
Total	100

Expectations:

- Attendance is expected all class and lab sessions as well as field trips. Please notify the instructor if you must miss any sessions.
- While collaboration on homework assignments is permitted, each assignment submitted must represent essentially your own work. Submitted work that is copied from peers is subject to severe penalization.
- Homework assignments should be submitted on engineering paper and the work should be neat, complete, and logically arranged.
- If you have germane questions or comments about course material, you are expected to offer them. Other students probably share your question, and would appreciate your insights.

Table 1: Semester class period schedule.

Period #	Date	TOPIC	Assigned Reading
PRELIMINARY CONCEPTS			
1	1/22	Overview of the Course	Text, Ch. 1&2
2	1/24	Energy; Atomic Structure; Theoretical Strength	
3	1/29	Surface Energy; Griffiths Microcrack Model	
STRUCTURAL METALS			
4	1/31	Steel microstructure, metallurgy and processing	Text, Ch. 3
5	2/05	Grades of structural steels and properties	
6	2/07	Steel corrosion & durability issues	
7	2/12	Aluminum metallurgy & alloys	Text, Ch. 4
8	2/14	Comparative mechanical properties & costs	
PORTLAND CEMENT CONCRETE			
9	2/19	Aggregates for concrete: gradation, texture	Text, Ch. 5
10	2/21	Moisture contents	
11	2/26	Portland Cement Chemistry	Text, Ch. 6
12	2/28	The hydration reaction, types of cement porosity	
13	3/04	Cement replacement materials	Text, Ch. 7
14	3/06	Portland cement concrete as a composite	PCA manual
15	3/11	Mixing, placement, curing of portland cement concrete	
16	3/13	Mechanical properties of portland cement concrete	
17	3/25	Durability issues with portland cement concrete	Mindness, ch.18
18	3/27	Review of Material covered to Date	
	3/27	Midterm Exam #1 at 7pm	
BITUMINOUS MATERIALS			
19	4/01	Asphalt, Tar, & their origins	Chapter 9
20	4/03	Classification of asphalt cements	
21	4/08	Rheology and aging (oxidation) of asphalts	
22	4/10	Mix design of asphalt cement concrete	
23	4/15	Cutbacks and emulsions	
FIBER-REINFORCED PLASTIC COMPOSITES			
24	4/17	Fibers; thermoplastics; thermosets	Chapter 11
25	4/22	Mechanics of composites; stiffness & strength properties	
26	4/24	Usage of FRPs in civil engineering	
MASONRY			
27	4/29	Basic Types; units; types of construction	Chapter 8
28	5/01	Mortar characteristics; Clay and concrete units	Supplemental
29	5/06	Shrinkage and expansion in masonry; Efflorescence	
30	5/08	Review & Discussion of final exam	
Final Exam	5/15	Period #19 Thursday, 7:30-9:30am	

REFERENCE MATERIALS (partial list): These materials are on reserve in the Lichtenberger Engineering Library.

Metals

- Metals Handbook, American Society for Metals, 1961.
- Structural Steel Designer's Handbook, R. Brockenbrough, F. Merritt, McGraw-Hill, 1994.
- Aluminum Alloy Structures, F.M. Mazzolani, Pittman, 1985.
- Mechanical Engineers' Handbook, M. Kutz (Ed.), Wiley, 1998.

Portland Cement Concrete

- Portland Cement Association (PCA) Literature (in electronic form)
- Concrete 2nd Ed., S. Mindess, J.F. Young, and D. Darwin, Prentice-Hall, 2003.
- Concrete Structure, Properties and Materials, P.K. Mehta, Prentice-Hall, 1986.
- Design and Control of Concrete Mixtures, 13th Ed., Portland Cement Association, 1988.
- Fly Ash Facts for Highway Engineers, <http://www.cf.fhwa.dot.gov/pavement/fatoc.htm> , FHWA-IF-03-019 (2003).

Bituminous Materials

- Hot Mix Asphalt Materials, Mixture Design and Construction, F.L. Roberts, P.S. Kandhal, E.R. Brown, D.Y. Lee, T.W. Kennedy, National Asphalt Paving Assoc., 1991.

Masonry

- Concrete Masonry Handbook for Architects, Engineers, Builders, W.C. Panarese, S.H. Kosmatka, F.A. Randall, Portland Cement Assoc., 1991.

General (All of the above topics and others)

- Construction Materials: their nature and behaviour, J.M. Illston (Ed.), E&FN Spon, 1996.
- The Science and Technology of Building Materials, H.J. Cowan and P.R. Smith, Van Nostrand Reinhold, New York, 1988.
- Materials for Civil and Highway Engineers, 3rd Ed., K.N. Derucher, Prentice-Hall, 1994.
- Civil Engineering Materials, R.K. Dhir and N. Jackson, MacMillan, London, 1988.
- The Science and Technology of Civil Engineering Materials, J.F. Young, S. Mindess, R.J. Gray, A. Bentur, Prentice-Hall, 1998.
- Foundations of Materials Science and Engineering 3rd Ed., W.F. Smith, McGraw Hill, 2004.

Table 2. Semester laboratory schedule. All labs meet in G430 SC.

Week of:	Lab Activity
1/21-1/25	No Lab
1/28-2/01	Introduction, and Setup of Groups
2/04-2/08	1.1 Tensile Testing Structural Metal Specimens
2/11-2/15	1.2 Torsion Testing of Structural Metals
2/18-2/22	1.3 Charpy Impact Test ¹
2/25-2/29	2.1 Sieve and Specific Gravity Analysis of PCC Aggregates
3/03-3/07	2.2 Portland Cement Concrete Mixing and Initial Tests*
3/10-3/14	2.3 PCC 7-day Compression Test
3/17-3/21	SPRING BREAK
3/24-3/28	2.4 PCC Tensile Strength (Split-cylinder & 3-point bend)
3/31-4/04	2.5 PCC 28-day Compression Test ²
4/07-4/11	3.1 Asphalt Binder Test*
4/14-4/18	3.2 Asphalt Mixing; Gyrotory Compaction; Specific Gravity Tests* ³
4/21-4/25	No Lab
4/28-5/02	4.1 Tensile Testing of Composite Materials
5/05-5/09	No Lab
5/12-5/16	FINALS WEEK (No Lab)

* Please wear old clothes that you don't mind getting dirty.

¹ Lab report #1 on tests 1.1-1.3 due by 4:30pm Friday February 29, 2008.

² Lab report #2 on tests 2.1-2.5 due by 4:30pm Friday April 11, 2008

³ Lab report #3 on tests 3.1-3.2 due by 4:30pm Friday April 25, 2008