

GEORGIA INSTITUTE OF TECHNOLOGY
School of Civil and Environmental Engineering
CEE 6590 Durability of Cement-Based Materials
Course Syllabus - Spring 2019

Instructor: Dr. Kimberly E. Kurtis
Office: Mason 4154
Office Hours: R 1:30-3, open door and by appt.
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Lecture: T,R 12-1:15
Classroom: DM Smith 104
Web: Canvas
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Course Objectives

- To develop a fundamental understanding of the chemical, physical, and mechanical aspects surrounding the durability of cement-based materials.
- To identify effective material selection, mixture design, and structural design characteristics that promote durability.
- To understand and apply existing models describing the structure and durability of cement-based materials.
- To develop an appreciation for the seminal research which forms the foundation for current understanding and for the emerging technologies which will allow advances in the state-of-the-art in the development of more durable cement-based materials.
- To integrate research and learning.
- To improve critical thinking and written and oral technical communication skills.

Honor Code:

This course will be conducted under the guidelines of the Georgia Tech Academic Honor Code. A copy of the code can be found at <http://honor.gatech.edu/content/2/the-honor-code>

Course Requirements:

Grading will reflect performance on 2 exams and several assignments, including:

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| HW1: Cement-based Materials Review | 5% | January 17 |
| HW2: Inspection Reports | 5% | January 29 |
| HW3: Journal Review/Club Discussion | 5% | February 12 |
| HW4: Virtual Experiment | 5% | February 23 |
| Midterm Quiz | 20% | February 26 |
| HW5: Critical Review – Detailed Outline/Sources | 5% | March 7 |
| Critical Review | 20% | April 2 (submitted), by April 23 (revised) |
| Critical Review Presentation | 5% | April 11, 16 and 18 |
| HWs 5/6: Peer Reviews | 5% | April 9 |
| Final Quiz | 20% | May 2, 11:20-2:10 |
| Class participation | 5% | |

Approximate grading scale:

90-100%=A 80-89%=B 70-79%=C 60-69%=D Less than 60%=F

Course materials:

- See course site at Canvas for course notes and announcements
- Required Text: (choose one)
 1. Mehta, P.K. and Monteiro, P.J.M., CONCRETE: Microstructure, Properties, and Materials, any edition.
 2. Mindess, S. Young, J.F. and Darwin, D. Concrete, Prentice-Hall, 2nd Edition, 2003.
- ACI student membership, with tokens.
- Additional required reading will be assigned, including ACI 201.2R Guide to Durable Concrete.
- Additional materials on Georgia Tech's library electronic reserve:
 1. PC Hewlett (Ed.) Lea's Chemistry of Cement and Concrete, Arnold, 2004. (new edition promised 3/18)
 2. VS Ramachandran and JJ Beaudoin (Eds), Handbook of Analytical Techniques in Concrete Science and Technology, William Andrews Pub/Noyes, 2001.
 3. K Scrivener, R Snellings, B Lothenbach (Eds), A Practical Guide to Microstructural Analysis of Cementitious Materials. CRC Press, 2016.

Tentative Course Outline

| TOPICS COVERED | DATE |
|---|--------------------------|
| Introduction | 1/8 |
| Condition assessment | 1/10 |
| OPC and ACM Binders and SCMs: Hydration and Multi-scale Structure | 1/15, <u>1/17</u> , 1/22 |
| Specification of Cements and other Binders | 1/24 |
| Analysis and characterization methods for concrete deterioration | <u>1/29</u> |
| Aggregate durability: ASR & ACR | 1/31, 2/5 |
| Abrasion, erosion, cavitation - Fire, Biodeterioration | 2/5, 2/7 |
| Journal Club | 2/12, 2/14 |
| Transport | 2/19, 2/21 |
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| MIDTERM QUIZ | 2/26 |
| Performance-based Specifications & Service life modeling | 2/28 |
| Damage due to Crystallization Pressure | <u>3/5</u> |
| Freeze/thaw and salt scaling (including deicers - ACI) | 3/7 |
| Sulfate attack | 3/12 |
| Delayed ettringite formation, Thaumasite formation | 3/14 |
| | |
| SPRING BREAK | 3/18-3/22 |
| Carbonation | <u>3/26</u> |
| Corrosion of steel in concrete | <u>3/28</u> |
| Multi-mechanism Degradation: Case Study | 4/2 |
| Alternative Binders and their Durability | 4/4, 4/9 |
| Critical Review Presentations | 4/11, 16, and 4/18 |
| Course wrap-up | 4/23 |
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| FINAL QUIZ | 5/2, 11:20-2:10 |