
**WESTERN UNIVERSITY - FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**CEE 9598a/b – Durability, Monitoring, and Rehabilitation of Concrete Structures
Course Outline – 2012/2013**

OBJECTIVES:

The objectives of this course are for the student to become able to:

1. Recognise the mechanisms of degradation of concrete structures and conduct preliminary forensic assessment of deteriorated concrete structures;
2. Learn how to conduct field monitoring and non-destructive evaluation of concrete structures;
3. Assess alternative repair strategies for deteriorated concrete structures including repairing with composites;
4. Evaluate stabilizing and strengthening techniques of reinforced concrete structural elements;
5. Carry out a study on a topic related to the durability and repair of concrete structures, author a technical paper on the study and present it verbally.

TOPICS:

Note that all topics may not be covered due to time constraints.

1. Introduction: properties of cement and concrete
 - a. Cement manufacturing
 - b. Cement hydration
 - c. Cement and concrete microstructure
 - d. Blended cements
 - e. Chemical admixtures
 - f. Special concretes
2. Causes and mechanisms of degradation of concrete structures
 - a. Corrosion of reinforcing steel
 - b. Freeze-thaw degradation
 - c. Alkali-silica reaction
 - d. Sulphate attack
 - e. Cavitation and abrasion
 - f. Moisture effects (plastic, autogenous and drying shrinkage, etc.)
 - g. Thermal effects
 - h. Load effects
 - i. Faulty workmanship: designer, detailer, contractor

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3. Monitoring and evaluation of concrete structures
 - a. Visual inspection
 - b. Non-destructive testing
 - c. Locating defects
 - d. In-situ tests
 - e. Monitoring movement

 4. Surface Repair of Concrete Structures
 - a. Strategy and design
 - b. Materials requirements and selection
 - c. Surface preparation
 - d. Bond of repair materials to existing concrete
 - e. Implementation methods

 5. Stabilization and strengthening of concrete structures with FRP
 - a. Bond of FRP to concrete joints
 - b. Flexural strengthening of beams
 - c. Shear strengthening of beams
 - d. Strengthening of columns
 - e. Seismic retrofit of columns

 6. Condition Survey and Evaluation of Concrete Structures
 - a. Preliminary investigation
 - b. Detailed investigation
 - c. Documentation
 - d. Case studies

 7. Litigation and Forensic Engineering
 - a. Litigation
 - b. Forensic Engineering
 - c. Case studies

 8. Term paper presentations of students on various related topics.

PREREQUISITES: CEE 3347a/3368, CEE 3369b or their equivalent, by permission of the Instructor.

CO-REQUISITES: None.

ANTIREQUISITES: None.

Note: It is the **student's responsibility** to ensure that all Prerequisite and Co-requisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the **student's responsibility** to ensure that they have not taken a course listed as an Anti-requisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Co-requisite or Anti-requisite conditions.

INSTRUCTOR: Dr. Moncef L. Nehdi, P. Eng., Professor
mnehdi@uwo.ca , Tel. 519 661-2111x88308, Office SEB 3083
Administrative support: SEB 3005.

TOTAL NUMBER OF CONTACT HOURS: 3 (discussion/lecture) hours/week.
Total: 36 hours.

COURSE MATERIALS:

Prepared class notes will be made available through the course OWL site at <http://owl.uwo.ca/>, along with other useful reference materials.

There is no set textbook for the course. There are a number of textbooks that cover many of the aspects of the course material, some of which are available through Western Libraries, either physically or online. These include:

- [1] Concrete Repair Manual, American Concrete Institute, 1999
- [2] Guide to Evaluation of Concrete Structures Prior to Rehabilitation, ACI Committee 364, 1994.
- [3] Service Life Prediction, State of the Art Report, ACI Committee 365, 2000.
- [4] Durability of Concrete in Cold Climates, E & FN Spon, by M. Pigeon and R. Pleau, 1995.
- [5] Guide to Durable Concrete, ACI Committee 201, 1992.

EVALUATION:	Final Examination	40%
	Term paper	40%
	Presentation, attendance and participation	20%
	Total	100%

TERM PAPER A term paper must be submitted two weeks before last class. Groups of up to three students can work on one term paper project. The paper must be written in the format of the ACI Materials Journal. The topic of the paper could be an original literature review of a concrete durability topic, a case study on repaired/rehabilitated structures, etc. Suggested topics will be provided by the instructor. A student can suggest a topic but needs approval of the instructor to proceed with the topic.

PRESENTATION Each student or group of students will have 15 to 20-minutes for presentation of their term paper followed by a 5-minute question period at least one week before the end of classes. The sequence of presentations will be determined randomly. The mark for presentation includes part marks for attendance of lectures and participation in class.

CONSULTATION: Students are encouraged to discuss course content and related issues with their instructor at the end of the lecture, or during individual consultations arranged by appointment.

Use of English:

In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Scholastic Offences:

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_grad.pdf.

Plagiarism:

University policy states that plagiarism, defined as the “act or an instance of copying or stealing another’s words or ideas and attributing them as one’s own.” (excerpted from Black’s Law Dictionary, West Group, 1999, 7th ed., p. 1170) is a scholastic offence. In submitting any written work as part of the coursework requirements for this course students must ensure that this work is written in their own words. Whenever students take an idea or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

A student who is found guilty of plagiarism in respect of any written work submitted as part of the coursework requirements for this course will be given a grade of zero for the submitted work. Repeated acts of plagiarism, either in this course or any other course subsequent to a first offence, will result in the student being given a failing grade for the course in which the subsequent offence occurs, and may also incur further penalties such as requiring the student to withdraw from the program in which they are enrolled in.

Attendance:

Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Accessibility:

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Conduct:

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, quiz or exam.

On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct: <http://www.uwo.ca/univsec/board/code.pdf>.