

PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
SCHOOL OF ENGINEERING
DEPARTAMENT OF CONSTRUCTION ENGINEERING AND MANAGEMENT
ABET COURSE SYLLABI

ICC3124 CONCRETE TECHNOLOGY

Credits and contact hours: 10 credits / 10 hours (3 h. Lectures, 1,5 h. Labs, 5,5 h. Independent learning experiences per week)

Instructor's name: Cristián Masana

Course coordinator's name Mauricio López

Textbook:

- Mehta, P.; Montero, P. (2006) Concrete: microstructure, properties and materials. 3rd edition, McGraw Hill.
- Neville, A. (1996) Properties of Concrete 4th edition, Pitman Publishing

Course Catalog Description:

Concrete is the most widely used manufactured building material in the world. Nevertheless, concrete is a material difficult to understand and work with given its highly complex microstructure and the dependency of its properties on time and the environmental conditions.

The course presents an integrated view on the behavior of concrete, both in the fresh and hardened state, based on the fundamental principles and scientific observations. The composition and properties of constituents will be discussed, considering its effect on the properties of concrete. Mixture design methods are thoroughly reviewed to enable the student to design concrete mixtures meeting specific constrains in fresh and hardened state. The workability of concrete is analyzed based on the principles of rheology and physical and chemical phenomena determining concrete's behavior during construction. Main properties of hardened concrete will be reviewed such as density, strength, elasticity, creep, and shrinkage considering concrete as a multi-phase material and emphasizing the effect of cement hydration and the micro-structure in the evolution of these properties. The course uses a project based methodology where students learn by applying concept in a concrete technology contest based on the ACI guidelines.

Prerequisite Courses: ICC2104 Technology of Civil Engineering Materials

Co-requisite Courses: None

Status in the Curriculum: Required

Course Learning Outcomes:

1. To identify, specify and evaluate the quality and properties of constituents of concrete to meet specific construction engineering specifications.
2. To analyze the factors affecting concrete properties in fresh and

hardened state and to specify procedures so those properties satisfy construction and design requirements respectively.

3. To analyze and control processes and pathologies of fresh concrete during construction.
4. To identify mixture design principles and procedures, to design concrete mixtures according to specific job requirements and adjust mix proportions based on actual results obtained on site or in the lab.
5. To implement procedures to evaluate the quality of concrete during construction operations.
6. To identify mechanisms that produce deformations in hardened concrete, evaluate the risk of cracking that affect the serviceability and durability of structures and to propose mitigation measures.
7. To design concrete mixtures that meet specification and perform laboratory experiments to verify their compliance.

**Relation of Course to ABET
Criteria:**

- a. Knowledge of mathematics, science and engineering
- b. Design and conduct experiments: analyze and interpret data
- c. Design a system, component, or process
- e. Identify, formulate, and solve engineering problems
- h. Broad education necessary for global, economic, environmental and societal context
- k. Techniques, skills, and modern tools for engineering practice.

Topics covered:

1. Introduction to Concrete: Importance of construction in concrete, background and general characteristics, requirements, classification, R&D challenges in technology and construction in concrete.
2. Concrete constituents, properties and conditions
3. Fresh concrete: concepts and workability definitions, conditions and factors that affect workability: Empirical procedures for testing workability, introduction to rheology and new procedures for testing wet concrete workability.
4. Fresh Concrete Processes: false set, segregation, bleeding, and volume changes and plastic cracking, setting time and pouring sequences, concrete formwork pressures.
5. Hardened Concrete Processes: density, strength (compression, tension and others i.e. fatigue, impact, abrasion, bond)
6. Mixture design: Basic Considerations and mixture design principles, methods, adjustments and verification.
7. Deformations of hardened concrete: types and definitions, elasticity and creep, effects and implications of restrained volumetric deformations, elastic properties, deformations and creep of hardened concrete.