



National University of Engineering (UNI)

School of Civil Engineering
Syllabus 2026-II

1. COURSE

CE3M1. Concrete Technology (Elective)

2. GENERAL INFORMATION

2.1 Course	: CE3M1. Concrete Technology
2.2 Semester	: 4 th Semester.
2.3 Credits	: 4
2.4 Hours	: 4 HT; 4 HP;
2.5 Duration of the period	: 16 weeks
2.6 Type of course	: Elective
2.7 Learning modality	: Face to face
2.8 Prerequisites	: BCH101. Chemistry I. (1 st Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

Concrete is the most widely used construction material in civil engineering worldwide. This course provides students with the knowledge required to understand the nature of its components (cement, aggregates, water, and admixtures), the design of mixtures using various methods, and the techniques of placement, consolidation, and curing. Understanding concrete technology is vital to ensure the durability, strength, and safety of infrastructure structures throughout their service life.

5. GOALS

- Understand the physical and chemical properties of concrete's components and their influence on mixture behavior.
- Design concrete mixtures using standardized methods to achieve specified strength and workability levels.
- Evaluate and control the quality of concrete in its fresh and hardened states through standardized tests.

6. COMPETENCES

ABET-1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (Usage)

ABET-2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (Usage)

ABET-6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (Usage)

7. TOPICS

Unit 1: Concrete Technology and Advanced Cementitious Materials (24 hours)	
Competences Expected: ABET-1,ABET-2,ABET-6	
Topics	Learning Outcomes
• Portland cement chemistry and hydration process • Aggregates properties and grading requirements • Mix design methodology for normal strength concrete • Fresh concrete properties including workability, slump, and setting time • Hardened concrete properties including strength, modulus, and shrinkage • Chemical and mineral admixtures for concrete • High-performance and high-strength concrete design • Self-consolidating concrete and fiber-reinforced concrete • Durability aspects including alkali-silica reaction, sulfate attack, and freeze-thaw • Sustainable and low-carbon concrete technologies including supplementary cementitious materials such as fly ash, slag, and silica fume	• Describe the chemistry of portland cement and the hydration process [Familiarity] • Evaluate aggregate quality and suitability for concrete production [Assessment] • Design concrete mixes for specified strength and workability requirements [Usage] • Test and interpret fresh concrete properties using standard procedures [Assessment] • Predict hardened concrete properties based on mix proportions and curing conditions [Usage] • Explain the function and effects of various concrete admixtures [Familiarity] • Formulate high-performance concrete mixes for demanding applications [Usage] • Select appropriate special concretes for specific construction scenarios [Assessment] • Incorporate supplementary cementitious materials to optimize concrete performance [Usage] • Analyze durability risks and specify protective measures for concrete structures [Assessment] • Compare environmental impacts and carbon footprints of different concrete formulations [Familiarity]
Readings : [KW16], [Nev11]	

Unit 2: Concrete Transport and Placement (20 hours)	
Competences Expected: ABET-1,ABET-2,ABET-6	
Topics	Learning Outcomes
• Transit mixer transport: maximum delivery time, slump verification, and admissible conditions • Concrete pumping: pumpable mix design, operating pressure, reach, and blockage prevention • Placement methods: direct discharge, chutes, buckets, and crane placement • Concrete consolidation: internal and external vibration, frequency, amplitude, and insertion depth • Underwater concrete placement by tremie method and in restricted-access conditions • Belt conveyor and pneumatic transport systems for large-volume concrete • Concrete surface finishing: leveling, troweling, texturing, and immediate curing	• Plan concrete transport considering delivery distance, setting time, and environmental conditions [Usage] • Execute standardized concrete placement procedures for different types of structural elements [Usage] • Apply correct vibration techniques to achieve uniform concrete consolidation [Usage] • Evaluate concrete placement quality and identify deficiencies such as segregation, honeycombs, and cold joints [Assessment] • Design pumpable concrete mixes for specific pumping height and distance conditions [Usage] • Specify placement methods for restricted-access structures or underwater placement conditions [Assessment] • Develop placement plans minimizing cold joints and ensuring concrete continuity in large structural elements [Usage]
Readings : [Nev11]	

Unit 3: Statistical Quality Control of Concrete (20 hours)	
Competences Expected: ABET-1,ABET-2,ABET-6	
Topics	Learning Outcomes
• Sampling procedures and fresh concrete specimen preparation according to ASTM standards • Compressive strength testing: procedure, minimum frequency, and testing conditions • Basic statistics applied to concrete: mean, standard deviation, and coefficient of variation • Concrete acceptance criteria according to ACI 318 and equivalent standards • Statistical control charts ($\bar{X}$, R) for continuous monitoring of concrete production • Non-conforming results analysis: investigation procedures, additional tests, and structural decisions • Process capability indices (C_p, C_{pk}) and target mean strength adjustment	• Apply standardized sampling and specimen fabrication procedures for concrete on site [Usage] • Interpret compressive strength test results and determine their validity [Assessment] • Calculate basic statistical parameters from series of concrete strength test results [Usage] • Evaluate concrete acceptance or rejection applying ACI 318 normative criteria [Assessment] • Construct statistical control charts for continuous monitoring of concrete production [Usage] • Diagnose causes of excessive variability and propose corrective actions in concrete production [Assessment] • Determine the target mean strength (f'_{cr}) considering the statistical variability of the production process [Usage]
Readings : [Nev11], [Lóp00]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

***** EVALUATION MISSING *****

10. BASIC BIBLIOGRAPHY

- [Lóp00] Enrique Rivva López. *Naturaleza y Materiales del Concreto*. 1st. Capítulo Peruano del American Concrete Institute, 2000.
- [Nev11] Adam Neville. *Properties of Concrete*. 5th. Pearson Education, 2011.
- [KW16] Steven Kosmatka and Michelle Wilson. *Design and Control of Concrete Mixtures*. 16th. Portland Cement Association (PCA), 2016.