National University of Engineering (UNI)
School of Civil Engineering
Syllabus 2027-I

1. COURSE

CE3C12. Virtual Design and Construction (Elective)

2. GENERAL INFORMATION

2.1 Course	:	CE3C12. Virtual Design and Construction
2.2 Semester	:	10^{th} Semester.
2.3 Credits	:	3
2.4 Hours	:	4 HT; 2 HP;
2.5 Duration of the period	:	16 weeks
2.6 Type of course	:	Elective
2.7 Learning modality	:	Face to face
2.8 Prerrequisites	:	• CE3C5. Costs and Budgeting in Civil Engineering. (9^{th} Sem) • CE3C2. Construction Technology II. (6^{th} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This elective was proposed directly by the Construction faculty responsible for the department's Construction Technology sequence, in order to keep the Civil Engineering program competitive with peer universities' dedicated Virtual Design and Construction (VDC) offerings, which that existing course sequence does not cover. Diseño y Construcción Virtual (VDC) introduces VDC as an integrated project-management methodology distinct from BIM-as-tool, develops hands-on REVIT authoring and Navisworks multidisciplinary coordination, clash detection, and 4D sequencing skills on a single staged project, integrates Lean Construction and Integrated Project Delivery (IPD) principles through constructability review, and culminates in a staged workshop deliverable: a coordinated BIM model with its 4D construction simulation. The course requires students to have already passed Planeamiento y Programación de Obras (CE2C5), Costos y Presupuestos en Ingeniería Civil (CE3C5), and Tecnología de la Construcción II (CE3C2), so that scheduling, cost, and construction-technology fundamentals are already in place before they are coordinated through BIM/VDC workflows.

5. GOALS

- Distinguish Virtual Design and Construction (VDC) as a project management methodology, grounded in Integrated Concurrent Engineering (ICE) sessions and ISO 19650 BIM Execution Plans, from BIM as a modeling tool.
- Author discipline-specific parametric models in REVIT and federate, coordinate, and clash-detect multidisciplinary models and 4D construction sequences in Navisworks, on a single staged project carried across the course.
- Apply Lean Construction and Integrated Project Delivery (IPD) principles, together with constructability review, through BIM/VDC workflows.
- Deliver, as a staged final workshop product, a coordinated multidisciplinary BIM model with its associated 4D construction simulation.

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)

7. TOPICS

Unit 1: Virtual Design and Construction (VDC) Foundations (12 hours)	
Competences Expected: ABET-2	
Topics	**Learning Outcomes**
• VDC as an integrated methodology: distinction between VDC and BIM as a tool • Integrated Concurrent Engineering (ICE) sessions and "Big Room" practice • ISO 19650 collaborative framework and project-level BIM Execution Plans (BEP) • Organizational roles and VDC adoption within a construction firm	• Distinguish VDC as a project management methodology from BIM as a modeling tool [Familiarity] • Plan an ICE session to coordinate a cross-disciplinary design milestone [Usage] • Develop a BIM Execution Plan (BEP) aligned with ISO 19650 for an original project [Assessment]
Readings : [KF12], [Int18]	

Unit 2: BIM Authoring and Coordination with REVIT and Navisworks (32 hours)	
Competences Expected: ABET-2	
Topics	**Learning Outcomes**
• Parametric modeling of architecture, structural, and MEP systems in REVIT • Federating multidisciplinary models in Navisworks • Clash detection and coordinated resolution • 4D sequencing: linking the BIM model to the construction schedule	• Model a structural or MEP system in REVIT at the required level of development (LOD) [Usage] • Federate architectural, structural, and MEP models in Navisworks [Usage] • Resolve a set of cross-disciplinary clashes through BIM coordination [Assessment] • Simulate the 4D construction sequence of a work item by linking the BIM model to the schedule [Assessment]
Readings : [Eas+11], [KR20]	

Unit 3: Lean, Constructability, and VDC (16 hours)	
Competences Expected: ABET-1	
Topics	**Learning Outcomes**
• Constructability review supported by the coordinated BIM model • Lean principles (flow, waste, pull planning) applied to VDC workflows • Integrated Project Delivery (IPD) and its contractual relationship to VDC	• Evaluate the constructability of a design from its coordinated BIM model [Assessment] • Apply a Lean principle (e.g. pull planning) to the planning of a VDC workflow [Usage]
Readings : [Fis+17], [Kos92]	

Unit 4: VDC Project Workshop (24 hours)	
Competences Expected: ABET-2	
Topics	**Learning Outcomes**
• Staged development of an integrated VDC deliverable across the course • Final presentation of the coordinated model and 4D simulation to the class	• Deliver a coordinated BIM model and its 4D simulation as the course's final integrated deliverable [Assessment]
Readings : [KF12], [Eas+11]	

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

[Kos92] Lauri Koskela. *Application of the New Production Philosophy to Construction*. Tech. rep. CIFE Technical Report #72. Center for Integrated Facility Engineering (CIFE), Stanford University, 1992.

[Eas+11] Chuck Eastman et al. *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors*. 2nd. Wiley, 2011.

[KF12] John Kunz and Martin Fischer. *Virtual Design and Construction: Themes, Case Studies and Implementation Suggestions*. Tech. rep. CIFE Working Paper #097. Center for Integrated Facility Engineering (CIFE), Stanford University, 2012.

[Fis+17] Martin Fischer et al. *Integrating Project Delivery*. Wiley, 2017.

[Int18] International Organization for Standardization. *ISO 19650-1:2018 – Organization and Digitization of Information about Buildings and Civil Engineering Works, Including Building Information Modelling (BIM) – Information Management Using BIM – Part 1: Concepts and Principles*. 2018.

[KR20] Eddy Krygiel and Phil Read. *Mastering Autodesk Revit*. Sybex / Wiley, 2020.