CA3171: INNOVATIONS IN CONSTRUCTION TECHNOLOGY

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Innovations in Construction Technology

Subject Code
CA - Civil and Architectural Engineering
Course Number
3171

Academic Unit
Architecture and Civil Engineering (CA)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
CA3618 Construction Technology / CA3703 Construction Methods and Equipment

Part II Course Details

Abstract

This course will explore specific form-finding and modularization strategies in structural design, utilizing physical and digital modeling techniques, but focusing more on the relationship between structural form and generative logic. With the continuous innovation of interactive design and simulation tools, we can study the interaction of boundary conditions, external loads, geometry, and internal forces, and better understand the laws of complex shape generation. The so-called complex form, the logical structure hidden under its appearance is the core part. This course will focus on the strategic research of generating complex forms, guide students to start from simple rules, continuously deepen the algorithm, add details, and finally complete the design and model production of parametric structures, as well as a series of design deliberation products.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Depict the assembly/construction principles for common building materials (e.g., concrete, masonry, steel and timber) and how it affects the decision-making in architectural design;			x	
2	Describe the construction methods of various types of structural elements, interior components, and site work;			x	
3	Enumerate the emerging issues in contemporary building construction and explain how to address the issues in architectural design;		x	x	
4	Illustrate the advancements in digital techniques and potential applications and/or integration of the techniques in architecture and construction.		x	x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Oral presentations delivered by the instructors covering various subjects related to material choices, construction methods, emerging issues, new technology, and pertinent architectural design considerations	1, 2, 3, 4	2

2	Tutorial, laboratory demonstration, and site visit	Case studies; demonstration of the digital techniques and construction technology in the laboratory or at actual construction sites	2, 3, 4	1

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Mid-term Test	1, 2, 3	10	
2	Assignments	1, 2, 3, 4	80	

Continuous Assessment (%)

90

Examination (%)

10

Examination Duration (Hours)

1.5

Additional Information for ATs

To pass a course, a student must obtain minimum marks of 30% in both coursework and examination components, and an overall mark of at least 40%.

Assessment Rubrics (AR)

Assessment Task

Mid-term Test

Criterion

1.1 Demonstrate understandings in the assembly/construction principles for common building materials (e.g., concrete, masonry, steel and timber) and how it affects the decision-making in architectural design.
1.2 Ability to explain the construction methods of various types of structural elements, interior components, and site work;
1.3 Ability to enumerate the emerging issues in contemporary building construction and explain how to address the issues in architectural design.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Assignments

Criterion

2.1 Demonstrate understandings in the assembly/construction principles for common building materials (e.g., concrete, masonry, steel and timber) and how it affects the decision-making in architectural design.
2.2 Ability to explain the construction methods of various types of structural elements, interior components, and site work;
2.3 Ability to enumerate the emerging issues in contemporary building construction and explain how to address the issues in architectural design.
2.4 Ability to illustrate the advancements in digital techniques and potential applications and/or integration of the techniques in architecture and construction.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Examination

Criterion

3.1 Demonstrate understandings in the assembly/construction principles for common building materials (e.g., concrete, masonry, steel and timber) and how it affects the decision-making in architectural design.
3.2 Ability to explain the construction methods of various types of structural elements, interior components, and site work;
3.3 Ability to enumerate the emerging issues in contemporary building construction and explain how to address the issues in architectural design.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- Building materials (concrete, masonry, steel, and timber); Construction methods (foundations, beams and columns, slabs and walls, roofs, stairs, openings, façade systems, and connections/joints); Interior components (flooring and ceiling systems, furnishing and equipment); Site works (external and landscape works);
- Modularity; Prefabrication; Environmental concerns and challenges; New materials; Introduction to sustainable design;
- Recent development of digital technologies (digital architecture, digital manufacturing, and digital fabrication); Smart construction; 3D-printing; Virtual reality and augmented reality.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Snyder V. Refabricating Architecture: How Manufacturing Methodologies are Poised to Transform Building Construction[J]. 2005.
2	Caneparo L, Cerrato A. Digital fabrication in architecture, engineering and construction[M]. Springer Netherlands, 2014.
3	Williams K. Digital Fabrication[M]//Digital Fabrication. Birkhäuser, Basel, 2012: 407-408.
4	Iwamoto L. Digital fabrications: architectural and material techniques[M]. Princeton Architectural Press, 2013.
5	Frazer J. An evolutionary architecture[J]. 1995.
6	Dunn N. Digital fabrication in architecture[M]. Laurence King Publishing, 2012.
7	Mazzoleni I. Architecture follows nature-biomimetic principles for innovative design[M]. Crc Press, 2013.
8	Pohl G, Nachtigall W. Biomimetics for Architecture & Design: Nature-Analogies-Technology[M]. Springer, 2015.
9	Terzidis K. Algorithmic architecture[M]. Routledge, 2006.
10	Architectural Design 0403 emergences
11	Architectural Design 0602 Mophogenetic Design
12	Steenson M W. Architectural intelligence: How designers and architects created the digital landscape[M]. mit Press, 2022.
13	Leach N. Design in THE age of artificial intelligence[J]. Landscape Architecture Frontiers, 2018, 6(2): 8-20.
14	Picon A. Digital culture in architecture[M]//Digital Culture in Architecture. Birkhäuser, 2010.
15	Agkathidis A. Generative design[M]. Hachette UK, 2016.
16	Negroponte N. Soft architecture machines[M]. Cambridge, MA: MIT press, 1975.
17	Carpo M. The alphabet and the algorithm[M]. Mit Press, 2011.
18	Negroponte N. The architecture machine[J]. Computer-Aided Design, 1975, 7(3): 190-195.
19	The digital turn in architecture 1992-2012[M]. John Wiley & Sons, 2012.
20	Carpo M. The second digital turn: design beyond intelligence[M]. MIT press, 2017.