Unit Title: Introduction to a Design Project for Engineers

Week	Content/ Concepts Covered	Engineering Activities	Learning Outcome	Technology Integration
1-2 (10 hours)	**Part 1: Introduction to Design Project for Civil Engineers** - Ultimate and serviceability limit state design, parties involved and flow of civil engineering project, sustainable issues and latest technology - Architectural drawing and structural key plans	**Lecture and Group Activities, Project 1: RC Building design CDIO project:** Students will be asked to form effective teams where each group consists of maximum 5 people, and choose a role for each person in the group. Each group must come out with the complete design and report of a double story house which fulfills following requirements: a) The layout of the house must adopt the specifications listed in Uniform Building by-laws (1984) b) The house must fulfill the fire safety and building regulations c) The design of the house must be cost effective. Work as a group and search for a set of architectural drawing which fulfills all the stated requirements.	**At the end of the lesson, students should be able to:** 1) Explain the application on the ultimate and serviceability limit state design 2) Identify the parties involved and the flow of civil engineering project 3) Explain discipline involve in civil engineering project 4) Demonstrate the knowledge on social, cultural, ethics and Sustainable development in design project 5) Identify requirements / specifications in Uniform Building bylaws and safety and building regulations. 6) Choose proper architectural drawing that satisfies the specifications in Uniform Building bylaws and safety and building regulations. 7) Sketch out the structural key plans for every floor of the chosen building.	**Supporting Technical Resources & Tutorials:** 1. Difference in Serviceability/Strength: What is the Difference between Strength and Serviceability? Combination definitions in the documentation based on different codes and standards: Load Combinations | SkyCiv Engineering Load combinations Tutorial: #8 Load Combinations - SkyCiv Structural 3D (S3D) Training 2. & 3. Introduction to SkyCiv for better understanding different modulus of Analysis and Design: Introduction to SkyCiv Introduction to SkyCiv Dashboard: Introduction to SkyCiv Dashboard 3. Sustainability in Civil Engineering is closely related to Embodied Carbon. Here's a blog page on SkyCiv's website: Structural Engineers and Embodied Carbon | SkyCiv

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		Group Discussion Activities: In a group, discuss and decide on how to find the position of the beams, slabs, and columns for every floor using color coding, and draw out the structural key plans for every floor. Groups will be called to present their key plans in front of the class. *(Students are expected to spend about 2 hours to fulfill this activity)*		
3-4 (10 hours)	**Part 2: Structural Loading Analysis** - Build analysis model - Load types, load paths, load combinations, roof truss design load	**Lecture and group activity Group activity (A&E):** In small groups, students will build a structural model, including beams, columns, rafters and slabs. This includes nodes, members, sections and plates if necessary. In small groups, discuss how to find all permanent and variable loads for roof and floors. Students will have to write down the permanent and variable loads based on the roof materials specified in the architectural drawings, and decide on the load path distribution from roof to roof beams. After discussing, some of the groups will be asked to present their results to the class. (Students are expected to spend about 2 hours to fulfill this activity)	**At the end of the lesson, students should be able to:** 1) Plan and build a model to represent structural framing including main frame, slab and roof 2) Prepare structure model using appropriate computer software 3) Differentiate the floor usage and finish floor level from the architectural drawing 4) Illustrate load path distribution of structure 5) Analyze loading from roof trusses and another external element to be included in design of structural elements.	1. SkyCiv S3D Module: SkyCiv Structural 3D Software To sketch out the structural plans, it is useful for students to understand how to sketch and use gridlines in S3D. This can be done in parts (for instance frame and truss modeled differently) YouTube Tutorial: Grids, Snapping and Drawing on SkyCiv Structural 3D 2. (Loading) This is part of the documentation and tech notes that discuss loadings: Loading | SkyCiv Engineering [Advanced, not required:] SkyCiv Load Generator Module: SkyCiv Wind Load Module Software

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		****Students to delegate slab, beam, column, and footing design tasks for each floor between members of the group **Activity (A&E):** In small groups, discuss how to find all permanent and variable loads for first floor and ground floor structure elements. Students will have to write down the permanent and variable loads for different room usage and finishes materials specified in the architectural drawings. After discussion, groups will be called to present their results to the class. (Students are expected to spend about 2 hours to fulfill this activity)		SkyCiv Load Generator Documentation: https://skyciv.com/docs/load-generator/ Load generator YouTube Tutorials: SkyCiv Load Generator Overview SkyCiv Integrated Load Generator SkyCiv Wind Load Generator Demo Design of a structure members such as beams and columns within S3D can be conducted through these modules: SkyCiv Member Design: Timber and Steel Member Design | SkyCiv Engineering SkyCiv Member Design Demo Documentation: Integrated Member Design | SkyCiv Engine
5 (8 hours)	**Chapter 3: Reinforced concrete structure Slab design** - Modeling of structure using computer software Chapter 3: Reinforced concrete structure design - Design of RC slab by manual and computer software	**Lecture and individual activity** **Group Activities:** 1) Students will be asked to choose a slab to design. 2) Use color pencil to draw the load path of the slab 3) Students should be able to calculate the value of loading using prior knowledge. 4) Students must draw BMD and SFD of the	**At the end of the lesson, students should be able to:** 1) Conduct analysis and design using appropriate computer software 2) Simulation of 3D model of structure using appropriate computer software. 3) Manually design of	**Analysis and Loadings are with these two modules:** SkyCiv Slab Design Module

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		slab using design standards. 5) Students must perform the complete design calculation for the slab based on prior knowledge. 6) Students are to compare design results from manual calculation with software outputs.	reinforced concrete slab 4) Justify design results from software	
6-7 (Hours 10)	**Chapter 3: Reinforced concrete structure Beam design** - Design of RC beam by manual and computer software	**Lecture and individual activity** **Group Activities:** 1) Each student is asked to find one simply supported beam and one continuous beam to be designed from the key plan. 2) Student's need to calculate the loading for the beams using prior knowledge. 3) Using prior knowledge from prior courses, students are required to apply method of sections and MDM in order to draw BMD & SFD. 4) Using prior knowledge from prior courses, students must perform the design for the beam. 5) Students must compare design results from manual calculation with software output	**At the end of the lesson, students should be able to:** 1) Manually design of simply supported and continuous reinforced concrete beam. 2) Justify design results from software.	**Related Modules to this task:** Tutorial on RC Beam Design SkyCiv RC Design: SkyCiv RC Design Software SkyCiv Reinforced Concrete Design Demo
	Part 3: Reinforced concrete structure design - Design of RC column by manual and computer software	**Lecture and individual activity** **Studio activities:** 1) Each student is asked to choose any critical column to be designed.	**At the end of the lesson, students should be able to:** 1) Manually design of reinforced concrete column	**Related Modules to this task:** 1. SkyCiv S3D SkyCiv Structural 3D Software 2. SkyCiv RC Design:

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8 (5 hours)		2) Use prior knowledge, draw a substitution frame for further analysis. 3) Students must perform structural analysis of the frame in order to get the axial load and bending moment for the column. 4) Students must come out with classification of the column. 5) Students are to compare design results from manual calculation with software outputs.	2) Justify design results from software	https://skyciv.com/structural-software/reinforced-concrete-design/ SkyCiv Reinforced Concrete Design Demo What is a Column Interaction Diagram
9 (5 hours)	**Part 3: Reinforced concrete structure design** -Design of RC foundation by manual and computer software	**Lecture and group activity** **Group activities:** 1) Based on earlier frame analysis of column and beam reactions, students should come out with the complete design of pad footing. 2) Students are to compare design results from manual calculation with software outputs.	**At the end of the lesson, students should be able to:** 1) Manually design of reinforced concrete foundation.	SkyCiv Foundation Design: SkyCiv Foundation Design Software

We welcome your feedback, please email us at education@skyciv.com if you have any questions, comments or suggestions with this lesson.