DSGN C4501: Structural Design and Analysis II

Module Title:	Structural Design and Analysis II
Language of Instruction:	English

Credits:	5

NFQ Level:	8

Module Delivered In	1 programme(s)

Teaching & Learning Strategies:	Lectures; Project work; Private study

Module Aim:	The aims of this module are: 1.) to develop the skills required to analyse the force distributions and deflections in 2 dimensional frames; 2.) to develop an understanding of the plastic theory of structures in relation to beams, 2d frames and reinforced concrete slabs; 3) to develop an understanding relevant to civil engineering structures of the structural dynamics of beams; 4) to develop the skills to use computer programs for the analysis of beams and 2d structures. 5) to extend the learner's knowledge of foundation design, portal frame type building including wind loading analysis and the design of composite floor beams. 6) to have an understanding of the the long and short term implications of material section and construction type and method

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Analyse the shear force, bending moment and deflections of beams and 2d frames relevant to civil engineering using hand methods of calculations
LO2	Analyse the shear force, bending moment and deflections of beams and 2d frames relevant to civil engineering using commercially available software programs for frame analysis
LO3	Qualitatively analyse continuous beam and 2d structures for deflection, shear and bending moment.
LO4	describe, design and calculate the embodied carbon of structural foundation in reinforced concrete for broadly defined engineering problems to the relevant National and European design standards.
LO5	describe, design and calculate the embodied carbon of a steel portal frame type buildings including wind loading to the relevant National and European design standards.
LO6	describe, design and calculate the embodied carbon of a steel and concrete composite floor beams for broadly defined engineering problems to the relevant National and European design standards.
LO7	To understand the implications of long and short term sustainability (construction and long term carbon footprint) when selecting a particular material and construction type and method, and the long term implications of construction maintenance.

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*
No incompatible modules listed
Co-requisite Modules
No Co-requisite modules listed
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*
Structural Analysis I

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Module Content & Assessment

Indicative Content
Influence Coefficient Theorems (a) Maxwells and Betti's theorems - Reciprocality of influence coefficients in elastic structures - proof (b) Muller-Breslau's principle - Proof of Theorem, Application to simple beam to produce influence lines, Application to continuous beams to produce influence lines
Analysis of continuous beams and 2d frames (a) Differential settlement and thermal gradient effects (b) Beams, 2d sway and non sway frames analysed using i. Moment distribution ii. Virtual work iii. Stiffness method (slope deflection) (c) Qualitative analysis for deflection, shear force and bending moment.
Computer analysis for beams and 2d structures (a) Analysis of deflections and forces for single span and continuous beams (b) Influence lines for continuous beams (c) Analysis of forces and deflections for 2d frames (d) Modelling of non prismatic members and curved members (e.g. arches)
Load Sharing Between Structural members (a) Load sharing based on structure stiffness (b) Shear wall systems and load distribution
Arch Structures (a) Analysis of statically indeterminate 3 pin arches. (b) Analysis of 2 pin statically indeterminate arches using strain energy (Castigliano) and virtual work approaches. Use of numerical methods of integration to resolve formulae thus derived.
Impact Loading n/a
Theories of Failure (a) Brief introduction to theories of failure
Structural Dynamics (a) Free undamped vibration (b) Free damped vibration (c) Forced damped vibration (d) Damping methods in real structures (e) Vibration of simple structures – cantilever beam, simply supported beam, Rayleigh's Method for beams in flexure.
Plastic Theory for Structures (a) Elastic-plastic stress-strain relation (b) Plastic bending without an axial force (c) Effect of axial load on plastic moment (d) Collapse loads and collapse mechanisms: i. Mechanism condition; ii. equilibrium condition; iii. yield condition; iv. Fundamental theorems of plastic collapse - Uniqueness theorem, Upper bound theorem, Lower bound theorem; v. Work method and statical method; vi. Incremental collapse and shakedown (e) Plastic methods applied to continuous beams (f) Plastic methods applied to single bay portal frames (g) Plastic methods applied to multibay portal frames (h) Yield Line Analysis for Reinforced concrete slabs: i. Slab simply supported 4 sides; ii. Slab simply supported 3 sides, free on side 4; iii. Slab simply supported 2 sides, encastre 2 sides; iv. Slab encastre 4 sides; v. Slab encastre 3 sides, free on side 4
Stiffness Methods (a) Matrix Stiffness Method (b) General stiffness method
Design of Reinforced Concrete Foundations (a) Isolated column bases (b) Combined bases (c) Punching shear (d) Pile cap design (e) Calculate the embodied carbon
Steel Portal Frame Type Buildings (a) Dead, imposed and wind loads on portal frames (b) Analysis of portal frames (c) Restraints and member stability (d) Serviceability checks (e) Connections (f) Calculate the embodied carbon
Design of composite floor beams (a) Analysis of a composite section (b) Shear connectors (c) Design of a composite floor beam (d) Calculate the embodied carbon

Assessment Breakdown	%
Continuous Assessment	20.00%
Project	20.00%
End of Module Formal Examination	60.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Examination	n/a	1,2,3	20.00	n/a

Project

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Project	Design Projects	4,5,6	20.00	n/a

No Practical

End of Module Formal Examination

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	No Description	1,3,4,5,6,7	60.00	End-of-Semester

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	12 Weeks per Stage	6.00
Estimated Learner Hours	12 Weeks per Stage	6.00
	Total Hours	144.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_CMHCE_B	Bachelor of Engineering (Honours) in Civil Engineering	7	Mandatory