UCLouvain

lgciv1023

2019

Construction stability

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Saraiva Esteves Pacheco De Almeida João ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	Structural Mechanics (course LGCIV1022) and Strength of Materials (course LGCIV1031) *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
Main themes	The objective of the course is to study fundamental scientific and technical aspects linked to the understanding and analysis of structural materials and geomaterials in construction. The course aims at providing future engineers with an essential background on mechanics, geomechanics and properties of construction materials that will be useful throughout their study curriculum and professionally when managing civil engineering projects.
Aims	AA 1.1, AA 1.2, et AA 1.3 • Determine the degree of static indeterminacy of a structure and solve statically indeterminate structures with the flexibility method, considering additionally the particular cases of variations of temperature, elastic supports, and imposed displacements. • Identify the number of degrees of freedom of statically indeterminate structures and solve them manually with the stiffness method. • Draw the distribution of internal forces in frame structures with corresponding values, as well as the deformed configuration, of statically determinate and indeterminate structures. • Program a structural analysis code for 2D truss and frame structures, and compare with results from educational / commercial structural analysis software. • Understand the concepts and application of the finite element method. • Determine influence lines for statically determinate and indeterminate structures. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Written final exam.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Lectures based on course slides and exercises solving with student participation.
Content	• Revision of structural mechanics. • Statically determinate structures: computation of displacements with the unit dummy force method (Mohr's integration tables) and by integration of differential equations. • Statically determinate and indeterminate structures: external / global / internal indeterminacy. • Calculation of degree of static indeterminacy: intuitive and systematic approaches. • Flexibility (or force) method: primary system, static unknown(s), general solution procedure, compatibility equation, calculation of internal forces, computation of displacements (Pasternak's theorem). • Simplifications due to symmetry. • Statically indeterminate trusses. • Elastic supports: replacement method and adaptation method. • Thermal effects. • Imposed displacements and derivation of local stiffness matrix coefficients. • Stiffness (or displacement) method: degree of kinematic indeterminacy, free and restrained degrees of freedom, primary system, kinematic unknown(s), general solution procedure, equilibrium equation, calculation of internal forces. • Stiffness method *versus* Flexibility method. • Stiffness method (matrix form for computer implementation): global and local reference systems; beam and truss elements; disassembly and connectivity array; assembly, solution, and support reactions; properties of the stiffness matrix; condensation and beam with hinge element.

	• Finite element method: meshing, finite element, nodes, and types of finite elements; boundary conditions (kinematic and static); weak and strong formulations; Galerkin method, displacement and virtual displacement fields, interpolation functions; application to 2D beam element; general application examples. • Influence lines: statically determinate and indeterminate structures.
Inline resources	• Lecture slides (available on Moodle) • For the matrix version of the sitffness method, a MatLab code will be provided.
Bibliography	• « Calculer une structure, de la théorie à l'exemple », P. Latteur, Editions L'Harmattan/Academia. • « Analyse des structures et milieux continus », Volume 4 : Structures en barres et poutres, Pierino Lestuzzi et Léopold Pflug, Presses polytechniques et universitaires romandes.
Other infos	The didactic analysis software "issd" (www.issd.be) is an advised complement and its use during the exercise sessions will help to the understanding of the course content.
Faculty or entity in charge	GC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Engineering : Architecture	ARCH1BA	5	LGCIV1031 AND LGCIV1022	
Minor in Engineering Sciences: Construction (only available for reenrolment)	LGCE100I	5		
Minor in Construction	LFSA132I	5		
Specialization track in Construction	LGCE100P	5	LGCIV1031 AND LGCIV1022	