INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Structural Concrete II			Field of study	Mechanics of Materials and Structural Concrete		
Bachelor in	Civil Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9089-322-3201-00-22		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Manuel Teixeira Brás César

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the structural behavior of the tridimensional systems of reinforced concrete, in complement to the acquired knowledge on previous EB 1 UC.
2. Understand the behavior of reinforced concrete slabs. To enunciate the equations that govern the structural and to identify the different parameters governing overall structural performance.
3. Know and to understand the physical models, and the characteristics of adequated structural behavior of reinforced concrete constructions.
4. Distinguish and to define the relations between the applied loads, the generated stresses and the capacity of laminar members.
5. Relate the efforts of the axial type, shear, torsional and flexure with the safety verification of structural elements of reinforced concrete.
6. Know and to adequately apply codes and standards related to reinforced concrete structures design.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Know the properties of the materials. To be able to obtain support reactions and efforts diagrams.
2. Analyze both isostatic and hiperstatic structures.
3. Be familiar with ultimate design of prismatic members (EB 1).

Course contents

Design of slabs. Detailing os slabs reinforcement. Support walls. Design and detailing of foundations. Deep beams. Corbeils. Stairs slabs.

Course contents (extended version)

1. Design of slabs.
   - Introduction - classification.
   - Linear elastic model for thin slabs.
   - Elastic analysis with redistribution of efforts.
   - Theory of the plasticity in reinforced concrete solid slabs.
   - Design of ribbed slabs.
   - Ultimate limit state design in reinforced concrete slabs.
   - Serviceability limit state.
   - Design of flat slabs.
   - Prestressed concrete slabs.
2. Detailing of members and particular rules.
   - Geometry. Minimum reinforcement.
   - Reinforcement spacing.
   - Curtailment of longitudinal tension reinforcement.
   - Positioning of the reinforcement.
   - One way solid slabs.
   - Two way solid slabs.
   - Reinforcement against concentraded loads.
   - Shear reinforcement.
   - Openings in slabs.
   - Flat slabs.
3. Retaining walls.
   - General. Vertical reinforcement.
   - External safety of reinforced concrete walls.
   - Internal safety of reinforced concrete walls.
4. Foundations.
   - Introduction.
   - Pile caps. Column and wall footings.
   - Deep and half-deep foundations. Wells. Tie beams. Column footing on rock.
5. Deep beams.
   - General.
   - Theoretical span. Minimum thickness.
   - Flexural design.
   - Shear design.
   - Detailing.
6. Corbels.
   - Introduction.
   - General.
   - Design criteria.
   - Detailing.

Recommended reading

1. NP EN 1990 : Eurocódigo - Bases para o projecto de estruturas. 2009
2. NP EN 1991 : Eurocódigo 1 - Acções em estruturas. 2010
3. NP EN 1992-1-1 : Eurocódigo 2 - Projecto de estruturas de betão - Parte 1-1: Regras gerais e regras para edifícios. 2010
4. CEB-FIP, Model Code 1990, in Comité Euro-International du Béton. 1993, Thomas Telford Services Ltd: Lausanne.
5. Montoya, P. J. , Á. G. Meseguer, F. M. Cabré, Hormigón Armado. edição, vols. 1 e 2, 1994, Barcelona: Editorial Gustavo Gili, S. A. 710.

Teaching and learning methods

Presencial time (60 hours): The unit will be taught using a combination of lectures, self-guided learning and practice classes. Non-presencial time (102 hours):

Teaching and learning methods

Individual or in teams solving of a set of proposed assignments and ilustration problems.

Assessment methods

- General - (Regular, Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 40% (theoretical part (8 points) and a practical part (12 points))
  - Development Topics - 60% (assignments/homework (problem sets and/or software develpment))

Language of instruction

1. Portuguese
2. English

Electronic validation

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07-06-2023	09-06-2023	13-06-2023	13-06-2023