INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Structural Concrete I			Field of study	Mechanics of Materials and Structural Concrete		
Bachelor in	Civil Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9089-322-3101-00-23		

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. Know basic concepts on structural safety. To know the material properties of concrete, steel and reinforced concrete. To understand the structural behaviour of structures made reinforced concrete.
2. Understand how reinforced concrete structures work. To enunciate the equations that govern the strength determination of reinforced concrete members.
3. Know and to understand the physical models and how they apply to the structural behaviour of reinforced concrete structures.
4. Distinguish and to define the relations between the applied forces, the generated efforts and the resistant capacity of reinforced concrete linear members.
5. Know the concepts needed to design reinforced concrete members. To relate the axial, shear, torsion and flexual efforts with the verification of the safety of reinforced concrete structural members.
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 obtain support reactions and efforts diagrams.
2. Analyze both isostatic and hiperstatic linear structures.
3. Be familiar with elastic design of prismatic members.

Course contents

Introduction. Basis of structural design. Reinforced concrete beams in flexure. Reinforced concrete beams in shear. Reinforced concrete beams in torsion. Reinforced concrete members subjected to compressive effort. Improved ductility on reinforced concrete structures.

Course contents (extended version)

1. Flexural behaviour.
   - Flexural behaviour of reinforced concrete members.
   - Moment-curvature relations.
   - Failure criteria of reinforced concrete cross-sections.
   - Basic design equations.
   - Flexural and shear interaction in linear regimen.
   - Elastic design and safety verification by means of safety stresses.
   - Ultimate design and safety verification with use of the the partial safety coefficients method.
   - Design and verification of the longitudinal reinforcement in linear members (beams and columns).
   - Use of design charts. Simplified rectangular stresses block.
2. Shear.
   - Behaviour of reinforced concrete members subjected to shear.
   - Shear truss model (Mörsch).
   - Shear interaction with flexure.
   - Concrete contribution to shear strength.
   - Design and verification of shear reinforcement in beams.
   - Translation of the force in the longitudinal reinforcement.
   - Résal effect.
   - The sewing rule.
   - Influence of some parameters in the shear strength.
3. Torsion.
   - Torsional behaviour of reinforced concrete members.
   - Torsion tubular truss.
   - Determination of torsion reinforcement.
   - Equilibrium and compatibility torsions.
   - Torsion combined with shear and flexural actions.
   - Torsion interaction with shear and flexure.
4. Compressive loaded members.
   - Behaviour of reinforced concrete members subjected do compressive load.
   - Buckling ultimate limit state.
   - Corrected column model method.
   - General detailing aspects.
   - Design and erection detailing for reinforced concrete beams and columns.
5. Special ductility structures.

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. Dimensionnement des Structures en Béton, vol. 8. R. Walther e M. Miehlbradt, Presse Polytechniques et Universitaires Romandes, EPFL, 1990.

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

Assessment methods

- General - (Regular, Student Worker) (Final, Supplementary, Special)
  - Practical Work - 40%
  - Final Written Exam - 60%

Language of instruction

1. Portuguese
2. English

Electronic validation

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29-09-2023	04-10-2023	10-10-2023	20-10-2023