Non-Linear Analysis and Behaviour of Concrete Structures (250707)

General information

School:	ETSECCPB
Departments:	751 - Departament d'Enginyeria Civil i Ambiental
Credits:	5.0 ECTS
Programs:	1140 - MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015)
Course:	2015/2016
Course language:	English

Faculty

Responsible faculty: Antonio Ricardo Mari Bernat

Teachers: Jesús Miguel Bairán García, Carlos Maria Lopez Garello, Antonio Ricardo Mari Bernat, Eva Maria Oller Ibars

Generic objectives

Subject to deepen the nonlinear phenomena and their effects in reinforced and prestressed concrete structures

Deepening in the nonlinear phenomena of concrete structures . Capability to evaluate the influence of these mechanisms in their design and calculation .

Causes of nonlinearity in concrete structures. Instantaneous and long-term behaviour of materials. Rheological models. Sectional analysis. Moment-curvature diagram. Nonlinear analysis strategies: incremental and iterative calculations. Newton-Raphson and Modified Newton-Raphson methods. Nonlinear analysis of 1D structures. Finite element method. Introduction to prestressing. Generalized matrix method. Analysis of evolutive construction processes. Two-dimensional elements. Concrete biaxial constitutive equations. Simulation of cracking and tension-stiffening .

Skills

Specific skills

To conceive and design civil and building structures that are safe, durable, functional and integrated into its surroundings.

Designing and building using traditional materials (reinforced concrete, prestressed concrete, structural steel, masonry, wood) and new materials (composites, stainless steel, aluminum, shape memory alloys?).

To evaluate, maintain, repair and strengthen existing structures, including the historic and artistic heritage.

To apply methods and advanced design software and structural calculations, based on knowledge and understanding of forces and their application to the structural types of civil engineering.

Generic skills of subject

To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.

To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.

To define construction processes and methods of organization and management of projects and works.

ECTS credits: total hours of student work

		Dedication	
		Hours	**Percent**
Supervised Learning	**Theory**	38.00	84.4%
	Assignments	7.00	15.6%
	Laboratory	0.00	0.0%
	Supervised activities	0.00	0.0%
Self-Learning		105.00	

Contents

Introduction

Dedication

6.0h. Theory

Description

Introduction

Nonlinear analysis strategy

Materials

Dedication

2.0h. Theory + 1.0h. Assignments

Description

Materials

Materials-problems

Nonlinear analysis strategy

Dedication

6.0h. Theory

Description

Structural analysis MEF

Different analysis and evolutionary construction

Dedication

6.0h. Theory

Description

Analysis time

FEM analysis estructural- rebar structures

Dedication

18.0h. Theory + 6.0h. Assignments

Description

Effects of deterioration and strengthening

Effects of shear

Shape memory alloys Safety in non-linear analysis Practical examples

Troubleshooting nonlinear mijançant software provided by teachers

Activities

Visit Structures Laboratory

Dedication

1.0 h. Self-Learning

Grading rules (*)

(*) The evaluation calendar and grading rules will be approved before the start of the course.

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

Test rules

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Teaching methodology

The course consists of 2,3 hours per week of classroom activity (large size group) and 0,3 hours weekly with half the students (medium size group).

The 2,3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,3 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Office hours

After class (Tuesdays at 19 pm), 45 minutes

Basic bibliography

- Marí, A.. **Nonlinear geometric, material and time dependent anaysis of reinforced and prestressed concrete frames.**. University of California, Berkeley. Berkeley, CA- USA. 1984.
- Bairán, J.M. **Nonlinear coupled model for the analysis of RC sections under combined bending, shear, torsion and axial forcess**. UPC. Barcelona. 2005.
- Van Mier, J. **Fracture processes of Concrete**. CRC Press. 1997.
- Ferreira, D., Bairán, J., Marí, A.. **Numerical simulation of shear-strengthened RC beams**. ELSEVIER. 2013.
- Marí, A., Oller, E., Bairán, J.. **Predicting the rsponse of FR-strengthened flexural members with no-linear evolutive analysis models**. 2011.

Complementary bibliography

- BAirán, J.M, Marí, A.. **Multiaxial-coupled analysis of RC sections subjected to combined forces**. ELSEVIER. 2007.