Course guide
250727 - 250727 - Performance Based Seismic Design and Assessment of Structures

Last modified: 28/03/2024

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: JESÚS MIGUEL BAIRÁN GARCÍA

Others: JESÚS MIGUEL BAIRÁN GARCÍA, JUAN MURCIA DELSO, LUCA PELA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13364. To conceive and design civil and building structures that are safe, durable, functional and integrated into its surroundings.
13365. Designing and building using traditional materials (reinforced concrete, prestressed concrete, structural steel, masonry, wood) and new materials (composites, stainless steel, aluminum, shape memory alloys?).
13366. To evaluate, maintain, repair and strengthen existing structures, including the historic and artistic heritage.
13369. 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.

Generical:
13360. To conceive, design, analyze and manage structures or structural elements of civil engineering or building, encouraging innovation and the advance of knowledge.
13361. To develop, improve and use conventional materials and new construction techniques to ensure the safety requirements, functionality, durability and sustainability.
13362. To define construction processes and methods of organization and management of projects and works.

TEACHING METHODOLOGY

The course consists of 3 hours lectures per week during one semester, where concepts are discussed together with problems, exercises and other supervised activities.
Along the course, the students will perform deliverable coursework or seminars. The students will require approximately 60 hours of personal work along the semester for personal study and development of deliverable work.
Classes may be complemented with laboratory practices (physical or virtual simulation of tests) and visits to the Structural Technology Laboratory of the UPC to assist to experimental testing, according to availability.
Support material will be available through ATENEA, as the guide of the course, the lectures programed schedule, content, evaluation, supervised activities material, bibliography and other support material.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

1. Comprensió general per aplicar enfocaments de disseny basats en el rendiment en el context de perills sísmics i altres.
2. Comprendre els fonaments de les incerteses i els mètodes per avaluar la fiabilitat estructural.
3. Definir els objectius de rendiment en els projectes de disseny i la seva quantificació.
4. Comprendre el comportament i el disseny d'edificis i ponts davant terratrèmols i altres accions extremes per mitigar els danys.
5. Avaluació del rendiment de les estructures mitjançant models adequats i realistes.
6. Comprendre i quantificar les conseqüències dels danys.1. Comprensión general para aplicar enfoques de diseño basados en el desempeño en el contexto de peligros sísmicos y de otro tipo.
2. Comprender los fundamentos de las incertidumbres y los métodos para evaluar la confiabilidad estructural.
3. Definir los objetivos de rendimiento previstos en los proyectos de diseño y su cuantificación.
4. Comprender el comportamiento y diseño de edificios y puentes ante sismos y otras acciones extremas para mitigar daños.
5. Evaluación del desempeño de estructuras utilizando modelos adecuados y realistas.
6. Comprender y cuantificar las consecuencias del daño.1. General understanding to apply performance-based design approaches in the context of seismic and other hazards.
2. Understand the fundamentals of uncertainties and methods to assess structural reliability.
3. Define target performance objectives in design projects and their quantification.
4. Understand the behaviour and design of buildings and bridges under earthquakes and other extreme actions for mitigating damage.
5. Performance assessment of structures using adequate and realistic models.
6. Understand and quantify the consequences of damage.

STUDY LOAD

Type	Hours	Percentage
Hours large group	25,5	20.38
Hours small group	9,8	7.83
Hours medium group	9,8	7.83
Self study	80,0	63.95

Total learning time: 125.1 h

CONTENTS

Introduction

Description:
Introduction

Full-or-part-time: 2h 24m
Theory classes: 1h
Self study : 1h 24m

Fundamentals aspects

Description:
Basis of structural dynamics
Basis of structural dynamics
Basis of probability and random processes
Basis of probability and random processes
Structural reliability
Structural reliability

Full-or-part-time: 24h
Theory classes: 7h
Practical classes: 3h
Self study : 14h

Performance engineering framework

Description:
Performance objectives
Consequence and damage measures

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Hazard and actions

Description:
Hazard and actions

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Structural behaviour under seismic and extreme actions

Description:
Structural behaviour under seismic and extreme actions

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

Design methods

Description:
Design methods based on forces, displacement, energy and damage control.
Design methods

Full-or-part-time: 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

Performance assessment through non-linear models

Description:
Performance assessment through non-linear models
Workshop non-linear assessment

Full-or-part-time: 28h 47m
Theory classes: 6h
Laboratory classes: 6h
Self study : 16h 47m

Seismic devices

Description:
Seismic devices
Seismic devices

Full-or-part-time: 7h 11m
Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m

Tests

Full-or-part-time: 4h 48m
Laboratory classes: 2h
Self study : 2h 48m

GRADING SYSTEM

The course will be assessed continuously by performing work deliverables and seminars (approximately 2 papers and 2 seminars will be held) and a written test at the end of the course.

The course grade will be computed as follows:
60% Exercises and coursework.
40% Exam

The minimum mark to pass is 5 over 10.

EXAMINATION RULES.

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

BIBLIOGRAPHY

Basic:
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- Paulay, T.; Priestley, M.J.N. Seismic design of reinforced concrete and masonry buildings. New York: Wiley & Sons, 1992. ISBN 0471549150.
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- Seismic bridge design and retrofit - Structural solutions. Lausanne, Switzerland: Federation Internationale du beton, 2007. ISBN 9782883940796.

Complementary:
- Displacement-based seismic design of reinforced concrete buildings. Lausanne, Switzerland: Fédération internationale du béton, 2003. ISBN 9782883940659.
- Priestley, M.J.N.; Calvi, G.M.; Kowalsky, M.J. Displacement-based seismic design of structures. Pavia: IUSS Press, 2018. ISBN 978-8885701052.
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