ES97P-15 Earthquake Resilient Structures

20/21

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Elia Gironacci
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES97P-15 Earthquake Resilient Structures

Module web page

Module aims

The aim of this module is to provide theoretical advanced concepts and procedures related to Seismic Engineering, able to build a comprehensive knowledge and the critical skills needed for the design of structures in seismic areas considering their functionality and Limit States. Fundamental and advanced concepts for the design of new structures in seismic areas will be covered, including aspects of using precast concrete solutions. Retrofitting of existing structures using Fibre Reinforced Polymers (FRP) and other materials will be also covered.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

PART A – Earthquake Engineering Principles

- Introduction to earthquake engineering (plate tectonics theory, seismic waves propagation, intensity, magnitude, site effects)
- Recalls of structural dynamics
- Structures characteristics and features (Structural regularity, stiffness, strength and ductility in seismic design)
- Earthquake input and loads to the structure according to EC, methods of analysis and structural response evaluation
- Seismic design

PART B – Seismic Design of Precast Structures

- Introduction to precast concrete
- Precast concrete systems and connections
- Basic considerations for the design of precast connections + design examples according to EC2
- Seismic design of precast connections + design examples according to EC8
- Horizontal floor diaphragms

PART C – Seismic Strengthening

- Introduction and materials
- Flexural FRP strengthening
- Shear/torsional FRP strengthening
- FRP confinement
- Alternative strengthening techniques

The module will include 1 laboratory exercise.

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate comprehensive knowledge and understanding of theory, concepts and methodology necessary to solve complex dynamic problems
- Design complex structural systems in seismic areas
- Interpret and systematically apply design regulations for seismic actions
- Creatively design precast concrete solutions for applications in seismic areas
- Critically assess the structural performance of existing structures
- Comprehend how to use FRP and other traditional and advanced materials for retrofit of existing structures

Indicative reading list

Elnashai, A.S. & Di Sarno, L., 2008 “Fundamentals of Earthquake Engineering”, Wiley. ISBN 9780470024836
Clough. R.W. & Penzien, J., 2003, “Dynamics of structures”, McGraw-Hill. ISBN 9780923907501

fib, 2008, “fib Bulletin No 43, Structural connections for precast concrete building”. ISBN 9782883940833
Fardis, M.N., 2009, “Seismic Design, Assessment and Retrofitting of Concrete Buildings”, Springer. ISBN 9781402098420
Teng, J.G. & Chen, J.F. & Smith, S.T. & Lam, L., 2001, “FRP-strengthened RC structures”, Wiley. ISBN 9780471487067

View reading list on Talis Aspire

International

Earthquakes are not a major issue in the UK, but it is in numerous countries in the world (eg. Italy, Greece, Japan, USA). This module will give students the opportunity to apply design standards related to other countries.

Subject specific skills

- Interpret and apply advanced design standards for complex engineering problems
- Understand the effect of dynamic inputs on structures and make decisions accordingly
- Identify and apply advanced technological solution for retrofitting of existing structures in seismic areas

Transferable skills

- Work in a group for a project of high complexity
- Familiarise, interpret and apply design standards outside of the UK
- Use of complex IT tools for the study of structural problems

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Study

Study time

Type	Required	Optional
Lectures	24 sessions of 1 hour (16%)	
Tutorials	8 sessions of 1 hour (5%)	6 sessions of 1 hour
Practical classes	1 session of 3 hours (2%)	
Other activity	2 hours (1%)	
Private study	113 hours (75%)	
Total	150 hours	

Private study description

113 hours guided independent learning including design project

Other activity description

2 hours of practical class (Testing)

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A1

	Weighting	Study time	Eligible for self-certification
Assessment component			
Group Laboratory report	25%		No
Group Laboratory report (8 pages) including peer assessment			
Reassessment component is the same			
Assessment component			
Group Technical report	75%		No
Group Technical report with verification and validation by an oral presentation (maximum 20 pages) including peer assessment			
Reassessment component is the same			

Feedback on assessment

Support through advice and feedback hours.

- Feedback on technical during tutorials.
- Written feedback on marked laboratory report.
- Cohort-level feedback on laboratory report.
- Written feedback on marked technical report.
- Cohort-level feedback on technical report.

Availability

Courses

This module is Option list A for:

- Year 4 of UESA-H217 MEng Civil Engineering
- Year 4 of UESA-H114 MEng Engineering