# ES97P-15 Earthquake Resilient Structures

## 27/28

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

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## 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. [M2(M), M4(M), M5(M), M16(M)]
- Design complex structural systems in seismic areas. [M2(M), M4(M), M5(M), M16(M)]
- Interpret and systematically apply design regulations for seismic actions. [M2(M), M4(M), M5(M), M16(M)]
- Creatively design precast concrete solutions for applications in seismic areas. [M2(M), M4(M), M5(M), M16(M)]
- Critically assess the structural performance of existing structures. [M2(M), M4(M), M5(M), M16(M)]
- Comprehend how to use FRP and other traditional and advanced materials for retrofit of existing structures. [M2(M), M4(M), M5(M), M16(M)]

## Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

## 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 |
|---|---|
| Lectures | 24 sessions of 1 hour (16%) |
| Tutorials | 8 sessions of 1 hour (5%) |
| 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.

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## Assessment

You must pass all assessment components to pass the module.

### Assessment group A4

| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|
| **Assessment component** | | | |
| Group Laboratory report | 25% | | No |
| Group Laboratory report (8 pages) including peer assessment | | | |
| **Reassessment component** | | | |
| Individual Laboratory Report | | | No |
| Individual laboratory report (5 pages) | | | |
| **Assessment component** | | | |
| Group Technical report | 75% | | No |
| Group Technical report (maximum 20 pages) including peer assessment | | | |
| **Reassessment component** | | | |
| Individual technical report | | | No |
| Individual technical report on the design on selected structural elements in a concrete structure (12 pages) | | | |

### 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.

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## Availability

## Courses

This module is Optional for:

- UESA-H212 MEng Civil Engineering with Intercalated Year
    - Year 5 of H212 Civil Engineering with Intercalated Year
    - Year 5 of H20N Civil Engineering with Intercalated Year with Appropriate Technology
    - Year 5 of H20G Civil Engineering with Intercalated Year with Business Management
    - Year 5 of H20J Civil Engineering with Intercalated Year with Fluid Dynamics
    - Year 5 of H20H Civil Engineering with Intercalated Year with Sustainability
- Year 4 of UESA-H114 MEng Engineering
- UESA-H115 MEng Engineering with Intercalated Year
    - Year 4 of H115 Engineering with Intercalated Year MEng
    - Year 5 of H115 Engineering with Intercalated Year MEng

This module is Core option list A for:

- UESA-H218 MEng Civil Engineering with Intercalated Year
    - Year 4 of H218 Civil Engineering with Intercalated Year
    - Year 5 of H218 Civil Engineering with Intercalated Year