CE 413 EARTHQUAKE ENGINEERING

Co-ordinator: Dr J.J. Bommer (Room 324), Email: j.bommer@imperial.ac.uk

Status: Elective

Lecturers: Dr J.J. Bommer (JJB)
Dr. A.Y. Elghazouli (AYE), Room 440, a.elghazouli@imperial.ac.uk

Structure: 45 lecture and 6 project/tutorial hours

Links: CE402 : Useful

Introduction

In many areas of the world, there is a constant threat of strong earthquakes and the mitigation of their potentially destructive effects is primarily the responsibility of civil engineers. Even in areas of low seismicity, such as the UK, critical structures are designed for the effects of earthquakes that, although small and infrequent, can pose a threat to their integrity. The ground shaking caused by earthquakes can represent the most severe loading to which civil engineering works are subjected and the design of lifelines and buildings to resist seismic forces is a highly challenging branch of civil engineering.

The module begins with the processes of earthquake generation and the quantification of earthquake effects. On the basis of this introductory part of the module and the fundamentals of static structural design covered in previous years, the remainder of the module is dedicated to the specification of seismic design loads and the earthquake-resistant design of steel structures.

The module consists of a total of 51 contact hours, comprising lectures covering topics listed below in the syllabus, covering two broad topic areas. The module will include about 6 hours of tutorials in which the exercises and project can be discussed.

Aims

The aim of this module is to introduce to the student the fundamental elements of seismic hazard assessment, including the effects of soil deposits at the site, as well as to present the fundamental concepts of seismic design with emphasis on the earthquake-resistant design of steel structures. The overall objective of the module is to enable the student to view earthquakes as an exceptional loading case for engineered structures and to adopt rational approaches to providing adequate resistance against their potentially damaging effects.

SYLLABUS

Autumn Term : Seismic Hazard Assessment

WEEK	TOPIC	Lecturer
1	Concepts of risk and hazard; tectonics & faulting; earthquake hazards	JJB
2	Seismic waves and seismic phases; seismograms	JJB
3	Earthquake source parameters: location, magnitude and focal mechanism	JJB
4	Seismic sources and seismicity models	JJB
5	Intensity; accelerograms; strong-motion parameters	JJB
6	Earthquake response spectra; effect of soil layers of ground-motion characteristics	JJB
7	Ground-motion prediction relations	JJB
8	Introduction to seismic hazard assessment	JJB
9	Probabilistic seismic hazard assessment	JJB
10	Earthquake loads for design: response spectr and accelerograms	JJB
11	Earthquake loads in seismic design codes	JJB

Spring Term : Seismic Design of Steel Structures

WEEK	TOPIC	Lecturer
16	Introduction to seismic design	AYE
17	Structural forms and lateral resistance systems	AYE
18	Revision of structural dynamics concepts; earthquake loads and seismic analysis	AYE
19	Response of steel materials and components to earthquake loads	AYE
20	Seismic design of various forms of structural steel systems	AYE
21	Design of steel framed structures to Eurocode 8	AYE
22	Practical considerations for seismic design	AYE

Coursework and submission dates

Within each topic area there will be a number of tutorial exercises and project work based on real data and practical applications. For the Autumn Term lectures on seismic hazard assessment there will be a number of small exercises related to various aspects of defining ground-motion input to earthquake-resistant design. A single report will be submitted covering all of the exercises. For the Spring Term lectures on seismic design of steel structures, the coursework will consist of a design project, for which another report will be submitted. Both projects will be performed in groups of 3, with a single report required from each group.

Coursework	Issue of Coursework		Deadline for Submission (by 5pm)		
	Term	Week	Term	Week	Date
Strong Ground-Motion and Seismic Hazard Assessment	Autumn	3	Spring	15	14/01/05
Seismic Design Project	Spring	21	Spring	25	25/03/05

Assessment
The course is assessed on the basis of the coursework reports and a written examination. The two coursework reports, which are equally weighted, account for 40% of the total marks. In the written exam, five questions (of equal marks) are to be answered from a total of 8, five of the corresponding to the Autumn Term lectures and three to the Spring Term lectures; students are required to answer 3 questions from the Section related to the Autumn Term lectures and 2 from the other Section.

Recommended Textbooks/Reading:
DOWRICK, D.J., Earthquake resistant design for engineers and architects. *2nd edition, Wiley, 1987.*
KRAMER, S.L., Geotechnical earthquake engineering. *Prentice-Hall, 1996.*
NAEIM, F. (editor), The seismic design handbook. *Van Nostrand Reinhold, 1989.*
PRAKASH, S., Soil dynamics. *McGraw-Hill, 1981.*
REITER, L., Seismic hazard analysis: issues and insight *Columbia University Press, 1990.*

Learning Outcomes
After completing the module, students are expected to be able to approach problems of earthquake-resistant design with a full awareness of the basic issues and principles involved. Students are expected to develop basic competence in assessing seismic hazard, characterising earthquake actions, evaluating seismic response of soil layers, selecting structural configurations for seismic resistance, estimating earthquake loads, and designing structural steel elements to resist these loads.

This competence will be tested by the coursework and assessed by the two reports submitted. Understanding of underlying principles of engineering seismology and earthquake engineering, including awareness of intrinsic uncertainties and assumptions, will also be assessed by means of a written examination of 3 hours duration in the Summer Term.