UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

MASONRY STRUCTURES

Enrollment year	2020/2021
Academic year	2021/2022
Regulations	DM270
Academic discipline	ICAR/09 (CONSTRUCTION TECHNIQUES)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL ENGINEERING FOR MITIGATION OF RISK FROM NATURAL HAZARDS
Curriculum	Reduction of seismic risk
Year of study	2°
Period	1st semester (20/09/2021 - 13/10/2021)
ECTS	6
Lesson hours	53 lesson hours
Language	English
Activity type	WRITTEN TEST
Teacher	MAGENES GUIDO (titolare) - 6 ECTS
Prerequisites	The student should have command of the basic concepts of solid mechanics, structural analysis and design which are typically taught at BSc level in Civil Engineering curricula. Furthermore, he/she should know the concepts taught in the course of "Fundamentals of seismic design"
Learning outcomes	The goal of the course is to provide an introduction to materials, construction practices, structural behaviour, analytical methods, and typical code requirements for the design of new masonry buildings and the evaluation and retrofit/rehabilitation of existing ones, with special regard to seismic action. The student will learn how to calculate the structural response of masonry elements and systems subjected to gravity loading, lateral loading and seismic loading. In addition the student will learn the principles of design of new masonry structures and the strategies and techniques to retrofit the existing ones.

Course contents	• Introduction to masonry construction methods. Structural, non-structural, unreinforced, reinforced, stone, brick, block, partitions, parapets, infills, veneer. General structural layout and conception of a masonry buildings • Properties of masonry materials, compressive strength, modulus of elasticity, modulus of rupture, etc. • Mechanics of masonry in compression. • URM walls in compression (load bearing walls), effects of slenderness. • URM walls in bending (load bearing walls) • URM walls in bending and compression (out-of-plane), behaviour under lateral out-of-plane load (wind, seismic). • URM walls under in-plane lateral loads. Failure mechanisms/limit states. Strength formulae. Force-displacement behaviour. Bi-linear idealization. • Structural analysis of URM buildings. Idealizations under prevailing vertical loads, idealizations under horizontal loads. Rigid diaphragm systems, flexible diaphragm systems • Seismic response of URM building systems. Global analysis governed by in-plane response. Elastic analysis. Nonlinear analysis • Local out-of-plane seismic assessment/safety check of URM walls. • Lateral strength and behaviour of reinforced masonry (RM) walls. Flexural strength, shear strength, stiffness, detailing of reinforcement • Seismic response of RM buildings. Design and seismic performance assessment. • Confined masonry. • Behaviour of non-structural masonry components. • Review of modern codes approaches to seismic design and methods of analysis (linear static, nonlinear static, linear dynamic, nonlinear dynamic). • Assessment of seismic performance of existing buildings. Overview. Experience from past earthquakes and from experiments. Sources of vulnerability. Response mechanisms (reprise). • Performance-based criteria for seismic assessment with reference to recent codes • Assessment of seismic performance of existing buildings. The EC8 - Italian approach. Survey and knowledge levels, methods for assessment. Local mechanisms. Application of limit analysis. • Strengthening/retrofitting strategies and techniques.
Teaching methods	The module consists of a series of lectures, taught in English, on selected topics relevant to masonry structures, theis seismic behaviour and the related design, assessment and retrofit/strengthening problems. The support material (Powerpoint slides, scientific papers) will be in English and will be made available to students in pdf format. The lectures are accompanied by some practical/lab training sessions where the students will also be asked to solve selected problem assignments.
Reccomended or required readings	1. Handouts and scientific papers made available during the course 2. T.Paulay and M.J.N.Priestley, Seismic design and assessment of reinforced concrete and masonry buildings, Chapter 7, John Wiley and Sons, 1997 3. R. Drysdale and A. Hamid, Masonry Structures: Behavior and Design, 3rd ed., The Masonry Society, 2008.

	4. M. Tomaževi?, Earthquake resistant design of masonry buildings, Imperial College Press, London, 1999. 5. A.W. Hendry, Structural Masonry, 2nd ed., Palgrave Macmillan, 1998
Assessment methods	The final grading will be based 40% on the homework assigment and 60% on the final exam. The final exam is a written test consisting of a first "closed books" section (1 hour) where the student is asked to answer to a series of questions on the programme, and a second "open books" section (2 hours) where the student will be asked to solve numerically a series of problems.
Further information	
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile