From evidences of recent earthquakes to the prediction of the seismic behavior of masonry structures

Held by
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Venue: online
Date: 10 hours
Tuesday, April 27th 2021, 3:00 p.m. - 6:00 p.m.
Wednesday, April 28th 2021, 3:00 p.m. - 6:00 p.m.
Friday, April 30th 2021, 3:00 p.m. - 5:00 p.m.
Monday, May 3rd 2021, 3:00 p.m. – 5:00 p.m.

Abstract

Nowadays, the majority of existing buildings is made of masonry. The concept of recovering and retrofitting existing buildings is encouraged in the perspective of minimizing the environmental impact and also of preserving the cultural identity of the building tradition.
Numerous analytical and numerical approaches are today available to simulate masonry structures subjected to earthquake-type actions. The engineer should be aware how they are born and what are the potential and the limitations of each one. To this purpose, it is essential to know how buildings actually perform under earthquakes. Lessons learnt from recent Italian earthquakes are therefore important to structure the expert's knowledge in order to address his/her efforts to a meaningful assessment.
This course illustrates the common failures of existing masonry buildings hit by earthquakes, showing practical examples collected by direct on site experience after the 2009 L'Aquila, 2012 Emilia Romagna and 2016-2017 Central Italy earthquakes. Afterwards, the main analytical and numerical approaches applied by researchers and engineers are described, highlighting for each of them potential and limitations. Finally, non-linear dynamic analyses are presented as advanced tool to predict the dynamic response of rigid block models, with which the out-of-plane modes of masonry buildings are investigated. The comparison between non-linear dynamic and non-linear static analysis, the latter the approach illustrated in the Italian standards, is proposed with a critical eye. A simple MATLAB code will be written with the participants to show the behavior of a masonry wall under dynamic load.

The course is addressed to PhD students, post-doc researchers and anyone interested in developing skills on modelling techniques of existing buildings under earthquakes. The procedures illustrated for the non-linear dynamic analyses of rigid block models can be easily extended to components of industrial facilities and to generic non-structural elements that can be assimilated to rigid blocks, being the methodology presented a broad-spectrum approach.

Agenda

Day #1

Evidences collected from recent Italian earthquakes and lessons learnt from them

- Typical failure modes of existing masonry buildings
- Differences of structural responses in recent Italian earthquakes: the case of 2009 L'Aquila, 2012 Emilia Romagna and 2016-2017 Central Italy earthquakes

Day #2

Analytical and numerical models

- Discussion about the origin of analytical and numerical models suitable to simulate the behavior of existing buildings subjected to earthquakes
- Practical applications of finite element and discrete element models on simple structures
- What is the best way to model masonry buildings? Is an individual analysis sufficient or not?
- Philosophy of the 2018 Italian Standards

Day #3

Local analysis of masonry structures: rigid block models and dynamic approaches

- Kinematic and dynamic approaches: two different methodologies to analyze similar phenomena
- The rocking analysis on masonry structures: modelling procedures

Day #4

Local analysis of masonry structures: rigid block models and dynamic approaches

- Practical application: how to write a simple MATLAB code to perform a non-linear dynamic analysis of rigid block models

Linda Giresini's CV

Linda Giresini worked as Assistant Professor of Structural Design at the University of Pisa from 2016 to 2021 and is author of about 90 papers/book chapters published in international journals and conference proceedings about civil engineering.
She is owner of three patents in the field of seismic mitigation of existing buildings and assets of historical values. She has been cooperating for eight years with the Department of Civil Protection for developing models to assess seismic vulnerability of masonry and reinforced concrete structures and to promote low-cost and environmentally friendly retrofitting strategies.

Dr. Giresini's research interests include earthquake engineering, innovative dissipation devices for the mitigation of seismic risk, experimental tests on masonry and r.c. structures, seismic vulnerability assessment of existing buildings, sustainable and resilient infrastructures, low-cost structural solutions for developing countries, rehabilitation of archaeological sites. She is qualified as Associate Professor in Structural Engineering since 2018.

Le lezioni sono previste svolgersi online. Per richiedere la partecipazione inviare un'email a: linda.giresini@unipi.it e per conoscenza a renato.iannelli@unipi.it.