Tentative title: Seismic response of rocking elements

Duration: 4 hours

Proponent lecturers: Danilo D'Angela (RTDA at DIST) & Alessandro Contento (Associate professor at Fuzhou University)

Potential date: March/April 2025

Language: English

Participation mode: In-person and online

Technical-scientific context: The dynamics of rigid blocks and rocking-dominated elements has been systematically investigated since the '60s, and the so-called classical theory was initiated by the seminal work of Housner, although a few researchers addressed the issue even earlier. Researchers of the caliber of Priestley and Chopra studied the seismic response of rocking elements, and this topic remains a significant object of interest in current research. The study of the dynamics of rocking blocks has often been focused on monumental structures composed of freestanding elements, such as ancient Greek temples, identifying the key parameters governing the seismic response and developing a relatively robust assessment methodology. More recently, rocking has been adopted in passive and active seismic protection strategies for structures and infrastructures. Among them, some relatively recent research has focused on the potential structural benefits derived from the energy dissipation effects of soil-structure interaction of rocking structures. Several numerical investigations, case studies, and real applications have demonstrated that the protection strategies based on rocking motion can be efficient and cost-effective. However, several limitations in their application have still to be addressed. In very recent years, rocking has also been studied with regard to the seismic response of freestanding nonstructural elements, such as equipment and building contents. Despite researchers have been studying rocking dynamics for several decades, the topic still motivates and inspires contemporary researchers. Several research questions remain unanswered, and the full potential of rocking dynamics remains unknown.

Contents: The seminar will provide a bird's eye view of the dynamics of rocking blocks with regard to the diverse nuances and applications in literature and in practice. The aim of the seminar is to provide basic knowledge of the topic, possibly encouraging PhD students and researchers to deepen the matter further. In particular, the contents will include basic motion equations, an overview of the modeling challenges, significant research contributions, representative engineering applications, and future perspectives. Moreover, the ongoing research activities carried out at DIST will be discussed, with regard to the experimental and numerical assessment of rocking-dominated nonstructural elements.

Targeted audience: PhD students, researchers, and practitioners operating in the field of design and assessment of engineering structures, infrastructures, and nonstructural elements.

Main references from the proponents

- **Contento A**, Di Egidio A. Investigations into the benefits of base isolation for non-symmetric rigid blocks. Earthquake Engineering & Structural Dynamics 2009; 38(7): 849–866. DOI: 10.1002/eqe.870.
- **Contento A**, Di Egidio A, Pagliaro S. Dynamic and seismic protection of rigid-block-like structures with Combined Dynamic Mass Absorbers. Engineering Structures 2022; 272: 114999. DOI: 10.1016/j.engstruct.2022.114999.
- **Contento A**, Gardoni P, Di Egidio A, de Leo A. Probabilistic Models to Assess the Seismic Safety of Rigid Block-Like Elements and the Effectiveness of Two Safety Devices. Journal of Structural Engineering 2019; 145(11): 04019133. DOI: 10.1061/(ASCE)ST.1943-541X.0002431.
- Di Egidio A, **Contento A**. Seimic performance of two rigid blocks coupled through a Maxwell visco-elastic device. Engineering Structures 2024; 301: 117319. DOI: 10.1016/j.engstruct.2023.117319.
- Di Egidio A, Zulli D, **Contento A**. Comparison between the seismic response of 2D and 3D models of rigid blocks. Earthquake Engineering and Engineering Vibration 2014; 13(1): 151–162. DOI: 10.1007/s11803-014-0219-z.
- **D'Angela D**, Magliulo G, Cosenza E. Towards a reliable seismic assessment of rocking components. Engineering Structures 2021; 230: 111673. DOI: 10.1016/j.engstruct.2020.111673.
- **D'Angela D**, Magliulo G, Cosenza E. Seismic damage assessment of unanchored nonstructural components taking into account the building response. Structural Safety 2021; 93: 102126. DOI: 10.1016/j.strusafe.2021.102126.
- **D'Angela D**, Magliulo G, Cosenza E. Incremental Dynamic Analysis of Rigid Blocks Subjected to Ground and Floor Motions and Shake Table Protocol Inputs. Bulletin of the New Zealand Society for Earthquake Engineering 2022; 55(Early access). DOI: https://doi.org/10.5459/bnzsee.55.2.64-79.
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References supporting the seminar

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