UNIVERSITA' DEGLI STUDI DI NAPOLI FEDERICO II

DIPARTIMENTO DI STRUTTURE PER L'INGEGNERIA E L'ARCHITETTURA
CORSO DI DOTTORATO DI RICERCA IN
INGEGNERIA STRUTTURALE GEOTECNICA E RISCHIO SISMICO

XXXVI CICLO

Il sottoscritto prof. _____Gennaro Magliulo_____

(PO □ PA ☒ RU □ RTD □) afferente al Dipartimento di _____

__Strutture per l'Ingegneria e l'Architettura__S.S.D. (*indicare codice e nome per esteso*___Tecnica delle Costruzioni – ICAR09_)

CHIEDE

di essere inserito tra i possibili tutor di studenti di dottorato per il XXXVI ciclo.

1. Curriculum sintetico del proponente (max 500 parole)

Gennaro Magliulo since 2018 is associate professor at the dept. of Structures for Engineering and Architecture at University of Naples Federico II, where he teaches two master degree courses: Precast Structures and Healthcare Facilities. Since 2016 he is affiliate researcher at the Construction Technologies Institute of the National Research Council.
He was graduated in Civil Engineering, branch Structures, in 1997 with laude and got his Ph.D. in Engineering of the Structures in 2001. In 2001 he had a six-month post-doc position at University of Ljubljana, Slovenia, and between 2001 and 2002 he was visiting researcher at Technion in Israel.
He is currently tutor of 3 PhD students, one in the frame of the doctorate in Structural and Geotechnical Engineering and Seismic Risk at the University of Naples Federico II, and two in the frame of the doctorate in Environmental Phenomena and Risks at the University of Napes Parthenope. He has been tutor of further 7 PhD students, six in the frame of the doctorate in Seismic risk at University of Naples Federico II and one in the frame of the doctorate in Engineering of Materials and Structures at the same university. He also taught the course of Seismic Analysis of Buildings within the doctorate in Seismic Risk. He is currently member of the board of doctorate professors of the doctorate in Biology and Applied Sciences at University of Molise.
He is author of 6 patents and more than 200 articles, 50 of them published by international peer reviewed journals. His research concerns earthquake engineering and dynamics of structures, nonstructural components, r/c structures and precast

structures, in the fields of theoretical modelling, numerical analysis, experimental research and code activity.
He has been principal investigator of 23 international and national research projects, funded by either public or private entities.
He is member of the board of ACI Italy Chapter and of "Seismic Performance Of Non-structural Element" association, and member of the fib committee TG 6.17 "Retrofitting and repairing of precast structures in seismic areas". He is also member of ACI, of the European Association of Earthquake Engineering.
Since 2019 he is in charge of the quality certification of the master course in Structural and Geotechnical Engineering at University of Naples Federico II. In the frame of this master course, he has been tutor of more than 50 internships and more than 80 theses.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio	
n. _1____	*specificare tipologia di borsa: ateneo, pon, por, senza borsa, ecc.* *_____senza borsa_____*

3. Titolo della ricerca proposta
Seismic assessment of unanchored building components

4. Area tematica
Ingegneria Geotecnica □
Ingegneria Strutturale ☒
Rischio Sismico □

5. Sintesi del progetto di ricerca (max 500 parole. Stato dell'arte, obiettivi e breve programma previsto per le attività e)

INTRODUCTION AND MOTIVATIONS

The response of nonstructural components (NCs) is typically associated with most of the seismic risk related to the worldwide building systems and facilities. NCs are often extremely vulnerable and exposed to risk, especially for critical systems such as hospitals, schools, and industrial facilities.[1–4] Architectural and anchored elements have been extensively investigated in the last decades.[5,6] Therefore, regulations and codes supply relatively adequate methods for their assessment, often implementable by practitioners.[7,8] This has not been the case of unanchored NCs so far.[9,10] In fact, the assessment of unanchored building components is still in the early stage of the development. Most studies investigating the dynamics of unanchored components were typically addressed to monumental elements[11,12] or parts of (infra)structural systems[13,14], which typically differ from NCs (e.g., size/material, loading histories). Furthermore, the studies focussed on building components often neglected the building influence[15,16] Conversely, the building response should be directly considered to assess NCs, especially for seismic certification.[17]

Shake table testing is the best method for the assessment of (acceleration-sensitive) NCs. The available (testing) protocols were designed for anchored/constrained elements; however, they are frequently used for the evaluation and certification of unanchored components.[10,18] This application trend might result in unreliable estimations, as recent studies pointed out.[9,10] As an example, those protocols[17,19] lack low-frequency content, which is typically associated with severe damage to unanchored components.[9,10,18] Moreover, the protocols[17,19] might be critical when the building influence is expected to be particularly relevant on the component demands, as recent studies highlighted.[20] Therefore, novel methods and testing protocols should be developed to address this paramount issue.

AIMS AND OBJECTIVES

The project aims to produce new experimental methods specifically addressed to unanchored components hosted in (critical) buildings/facilities. This will be accomplished through the following objectives (referred to unanchored components):

(I) vulnerability assessment considering a wide range of earthquake scenario, by focussing on the filtering/magnification effects of a vast asset of buildings, and component characteristics/locations;

(II)quantitative characterisation of the criticalities of the current assessment approaches/methods;

(III)definition of novel assessment methods numerically and experimentally substantiated.

WORK PLAN

The activity will be organised in five work packages:

(1.a)critical assessment of the literature relevant to the assessment of unanchored components, considering both rigid/deformable elements hosted in critical/special buildings/facilities;

(1.b)technical investigation into the regulation/code provisions for acceleration-sensitive components, with a focus on unanchored elements and special facilities, e.g., protocols for hospitals or telecommunication facilities;

(2)development of numerical methods for the analysis of the dynamic response of unanchored elements, and experimental validation (e.g., shake table testing);

(3.a)vulnerability assessment of unanchored components considering a wide variety of applications, e.g., varying building/facility features, and component types/locations;

(3.b)quantitative characterisation of the criticalities of the current approaches, e.g., through vulnerability/reliability assessment;

(4)definition of novel methods for the assessment of unanchored components by optimized specification of the main features found to be correlated to the vulnerability of the components, e.g., new shake table protocols;

(5)evaluation of the explicit reliability of the developed methods, and quantification of the implicit risk associated with its implementation (e.g., within current codes).

REFERENCES

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2. Perrone, D., Calvi, P. M., Nascimbene, R., Fischer, E. C. & Magliulo, G. Seismic performance of non-structural elements during the 2016 Central Italy earthquake. *Bull Earthquake Eng* (2018) doi:10.1007/s10518-018-0361-5.
3. Miranda, E., Mosqueda, G., Retamales, R. & Pekcan, G. Performance of Nonstructural Components during the 27 February 2010 Chile Earthquake. *Earthquake Spectra* **28**, S453–S471 (2012).
4. Zareian, F. *et al.* Reconnaissance Report of Chilean Industrial Facilities Affected by the 2010 Chile Offshore Bío-Bío Earthquake. *Earthquake Spectra* **28**, 513–532 (2012).
5. Badillo-Almaraz, H., Whittaker, A. S. & Reinhorn, A. M. Seismic Fragility of Suspended Ceiling Systems. *Earthquake Spectra* **23**, 21–40 (2007).
6. Huang, B., Chen, S., Lu, W. & Mosalam, K. M. Seismic demand and experimental evaluation of the nonstructural building curtain wall: A review. *Soil Dynamics and Earthquake Engineering* **100**, 16–33 (2017).

7. *Minimum design loads for buildings and other structures*. (American Society of Civil Engineers : Structural Engineering Institute, 2010).
8. British Standards Institution & European Committee for Standardization. *Eurocode 8, design of structures for earthquake resistance.* (British Standards Institution, 2005).
9. D'Angela, D., Magliulo, G. & Cosenza, E. Seismic certification of unanchored components: reliability assessment of the ICC-ES AC156 protocol. in (2019).
10. Wittich, C. E. & Hutchinson, T. C. Development Of A Rocking-Period Centered Protocol For Shake Table Testing Of Unattached Stiff Components. in *Tenth U.S. National Conference on Earthquake Engineering. Frontiers of Earthquake Engineering* (2014). doi:10.4231/D3BN9X373.
11. Drosos, V. & Anastasopoulos, I. Shaking table testing of multidrum columns and portals. *Earthquake Engineering & Structural Dynamics* **43**, 1703–1723 (2014).
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13. Xie, Y., Zhang, J., DesRoches, R. & Padgett, J. E. Seismic fragilities of single-column highway bridges with rocking column-footing. *Earthquake Engng Struct Dyn* **48**, 843–864 (2019).
14. Zhang, J., Xie, Y. & Wu, G. Seismic responses of bridges with rocking column-foundation: A dimensionless regression analysis. *Earthquake Engng Struct Dyn* **48**, 152–170 (2019).
15. Dimitrakopoulos, E. G. & Paraskeva, T. S. Dimensionless fragility curves for rocking response to near-fault excitations. *Earthquake Engineering & Structural Dynamics* **44**, 2015–2033 (2015).
16. Petrone, C., Di Sarno, L., Magliulo, G. & Cosenza, E. Numerical modelling and fragility assessment of typical freestanding building contents. *Bulletin of Earthquake Engineering* **15**, 1609–1633 (2017).
17. International Code Council Evaluation Service (ICC-ES). *AC156 Acceptance Criteria for the Seismic Qualification of Nonstructural Components*. (2012).
18. Di Sarno, L., Magliulo, G., D'Angela, D. & Cosenza, E. Experimental assessment of the seismic performance of hospital cabinets using shake table testing. *Earthquake Engineering & Structural Dynamics* **48**, 103–123 (2019).
19. Federal Emergency Management Agency (FEMA). *Interim protocols for determining seismic performance characteristics of structural and nonstructural components through laboratory testing. Report No. FEMA 461*. (2007).
20. Petrone, C., Magliulo, G. & Manfredi, G. Floor response spectra in RC frame structures designed according to Eurocode 8. *Bull Earthquake Eng* **14**, 747–767 (2016).

6. Eventuali pubblicazioni del tutor sul tema di ricerca (max 10)

- Petrone, C., **Magliulo, G.**, Manfredi, G., 2016. Floor response spectra in RC frame structures designed according to Eurocode 8. Bull Earthquake Eng 14, 747–767. https://doi.org/10.1007/s10518-015-9846-7.
- Petrone, C., **Magliulo, G.**, Manfredi, G., 2015. Seismic demand on light acceleration-sensitive nonstructural components in European reinforced concrete buildings. Earthquake Engineering & Structural Dynamics 44, 1203–1217. https://doi.org/10.1002/eqe.2508.
- Di Sarno, L., **Magliulo, G.**, D'Angela, D., Cosenza, E., 2019. Experimental assessment of the seismic performance of hospital cabinets using shake table testing. Earthquake Engineering & Structural Dynamics 48, 103–123. https://doi.org/10.1002/eqe.3127.
- Di Sarno, L., Petrone, C., **Magliulo, G.**, Manfredi, G., 2015. Dynamic properties of typical consultation room medical components. Engineering Structures 100, 442–454. https://doi.org/10.1016/j.engstruct.2015.06.036.

- Petrone, C., Di Sarno, L., **Magliulo, G.**, Cosenza, E., 2017. Numerical modelling and fragility assessment of typical freestanding building contents. Bulletin of Earthquake Engineering 15, 1609–1633. https://doi.org/10.1007/s10518-016-0034-1.
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- D'Angela, D., **Magliulo, G.**, Cosenza, E., 2019a. Seismic certification of unanchored components: reliability assessment of the ICC-ES AC156 protocol. Presented at the SECED 2019 Conference, London.
- D'Angela, D., **Magliulo, G.**, Cosenza, E., 2019b. ICC-ES AC156 protocol vs real records: seismic response of freestanding components. Presented at the 4th International Workshop on the Seismic Performance of Non-Structural Elements (SPONSE).
- **Magliulo, G.**, Maddaloni, G., Petrone, C., 2013. A procedure to select time-histories for shaking table tests on nonstructural components, in: Proceedings of the 4th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering. M. Papadrakakis, V. Papadoupolus, V. Plevris (eds.), Kos Island, Greece. https://doi.org/10.13140/2.1.4693.8881.
- **Magliulo, G**., Petrone, C., Manfredi, G., 2017. Seismic Demand on Acceleration-Sensitive Nonstructural Components, in: Papadrakakis, M., Plevris, V., Lagaros, N.D. (Eds.), Computational Methods in Earthquake Engineering: Volume 3. Springer International Publishing, Cham, pp. 177–204. https://doi.org/10.1007/978-3-319-47798-5_7.

7. Eventuali progetti di ricerca finanziati in cui l'attività si inserisce

- Reaserch project titled "Code contributions concerning nonstructural components" funded by the Department of Civil Protection (duration 36 months: 01 Jan 2019-31 Dec 2021). National coordinator of the project: prof. Edoardo Cosenza. Coordinator of the reaserch unit at University of Naples Federico II: prof. Gennaro Magliulo.

- Reaserch project titled "Seismic assessment of temporary partitions and ceilings for operating rooms, and of glass partitions" funded by the company

Mangini srl (duration 48 months: 01 Apr 2017-31 March 2021). Principal Investigator: prof. Gennaro Magliulo.

8. Eventuali fondi disponibili a supporto dell'attività del dottorando (escluso finanziamento borse)

9. Informazioni relative ad un periodo di ricerca all'estero (minimo tre mesi) previsto per il dottorando (*indicare Università/ente di ricerca e docente/ricercatore di riferimento* con indirizzo mail) (max 300 parole)
The student will spend six months at the University of Greenwich UoG (UK) as a research fellow. This period will be related to the work package 3.a, approximately corresponding to the second year of studies. The student will perform the vulnerability analysis collaborating with Dr Marianna Ercolino and Dr Georgios Kampas, both academic members of UoG. Dr Ercolino is an expert in advanced numerical analysis of structures. Dr Kampas has relevant experience in (a) the dynamics of unanchored bodies and (b) the evaluation of seismic demands on acceleration-sensitive elements. **The collaboration with Dr Ercolino and Dr Kampas will enhance the modelling and simulation skills of the student. This will improve the quality of the vulnerability study by (a) strengthening the theoretical/phenomenological aspects of the research, and (b) refining the methods for the simulation of the coupled building-component response. Furthermore, UoG will provide extremely powerful computational facilities for the extended numerical study, i.e., the high-performing computing (HPC) system.** **During this period, the student will be involved in the research activities promoted by UoG. They will have the opportunity to participate in the events relevant to the research topic organized by other Institutions (e.g., lectures periodically arranged by the University College of London UCL, or by the Society for Earthquake and Civil Engineering Dynamics SECED.**

The research activity at the UoG will be an essential experience for the student in terms of personal, social, and professional life.

10. Eventuali collaborazioni con imprese/aziende sul tema di ricerca (max 300 parole)

The research project is of potential interest of all the companies producing unanchored components placed in seismic areas and of all the companies producing elements for the seismic protection of unanchored components.

The company Mangini srl has already shown its interest for this research. Some of their products are components potentially suffering rocking and overturning under high seismic actions, e.g. clean rooms, rooms in room, electrical and conditioning systems.

Companies can provide systems to be tested on shaking tables in order to asses the reliability of the exixting and under development protocols for shake table testing of unanchored nonstructural elements.

Napoli,__13 Feb 2020____ FIRMA

Il presente modulo va compilato in ogni sua parte ed inviato all'indirizzo di posta elettronica phd.dist@unina.it entro e non oltre **venerdì 14/02/2020**.