



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

XXXIX CICLO

I sottoscritti prof. Francesco Silvestri (PO ■ PA □ RU □ RTD □)
e dott.ssa Filomena de Silva (PO □ PA □ RU □ RTD ■), afferenti al Dipartimento di
Ingegneria Civile, Edile ed Ambientale, S.S.D. ICAR/07 Geotecnica,

CHIEDONO

di essere inseriti tra i possibili tutor di studenti di dottorato per il XXXIX ciclo.

1. Curriculum sintetico dei proponenti (max 500 parole)

Francesco Silvestri

Career

1986: M.Sc. in Civil Engineering at the University of Napoli Federico II, where he took the degree of Ph.D. in Geotechnical Engineering in 1991.

1990: Research engineer - Scientist assistant at the University of Texas at Austin (USA).

1990 to 1998: Research Assistant at the 'Department of Geotechnical Engineering' of the University of Napoli Federico II.

1998 to 2003: Associate Professor at the 'Department of Soil Defense' of the University of Calabria. 2003 to 2007: Full Professor at the 'Department of Soil Defense' of the University of Calabria.

2007 to date: Full Professor at the University of Napoli Federico II, currently at the 'Department of Civil, Architectural and Environmental Engineering'.

Research

Experimental and analytical research on characterisation and analysis of mechanical behaviour of soils under time-variable loads, relevant to working and seismic conditions of buildings and infrastructures.

Specific research topics:

- advanced experimental techniques for measurement of soil mechanical properties;
- constitutive modelling of cyclic/dynamic soil behaviour in pre-failure conditions and at liquefaction;



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- embankments, levees, earth dams, coastal and underground structures under working and seismic loading;
- geotechnical characterisation, seismic response analysis and microzonation of small to large urban centers;
- ground deformations, soil liquefaction, instability of slopes and cavities induced by earthquakes and other natural events;
- soil-foundation-structure interaction for buildings and bridges with shallow or deep foundations;
- propagation, effects and attenuation measures of man-made vibrations;
- ground improvement and early warning technologies for seismic risk reduction.

On the above mentioned research topics, he published more than 300 papers with a h-index = 26.

Appointed as general or panel session reporter, chairman and discussion leader at national and international conferences.

Organizing activities

Guest editor and reviewer of technical papers for National and International Journals and Conferences.

Member of national/international Technical Committees on geotechnical testing, design codes and earthquake geotechnical engineering.

Italian delegate to the International Technical Committee of ISSMGE on 'Earthquake Geotechnical Engineering' since 2006.

Co-chairman of WG6 (Geotechnical Earthquake Engineering) of EAEE (European Association of Earthquake Engineering) since 2015 to 2019.

Member of Organising Committees and Editor of the Proceedings of national/international conferences.

Chairman of the VII International Conference on Earthquake Geotechnical Engineering (Roma, 2019).

Principal Investigator of institutional Research Units in the national Research Projects on soil dynamics and earthquake engineering.

Coordinator of the support about geotechnical aspects to the Department of Civil Protection in the emergency after the Aterno valley earthquake in 2009, the Ischia earthquake in 2017, and the Casamicciola landslide in 2022.

Task coordinator in the national research project ReLUIS since 2010 to date.

Principal Investigator of international research projects.

Participation in investigation projects with private financing.



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Teaching

Courses on 'Soil Dynamics and Earthquake Geotechnical Engineering' and 'Static and Seismic Foundation Design' - M.Sc. Degree in 'Structural and Geotechnical Engineering' - University of Napoli Federico II (Italy).

Short Course on 'Soil dynamics and non-linear site response analysis' - International Master Erasmus Mundus Courses on 'Geomechanics, Civil Engineering and Risks (MGCER)' and on 'Earthquake Engineering and Engineering Seismology (MEEES)' - Laboratoire 3SR - University of Grenoble Joseph Fourier (France).

Short Course on 'Soil Behaviour and Soil-Structure Interaction in Seismic Conditions' (lectures on Fundamentals of Soil Dynamics and Seismic response analysis) - PhD Program in Civil, Chemical and Environmental Engineering - University of Genova (Italy).

Coordinator of international agreements with the Aristotle University of Thessaloniki (Greece) and the University of Cuyo at Mendoza (Argentina) with Erasmus + .

Supervisor of 15 PhD theses in Geotechnical Engineering or Seismic Risk.

Filomena de Silva

Career

2012: M. Sc. in Architectural Engineering at the University of Napoli Federico II, Italy

2016: PhD in Seismic risk at the University of Napoli Federico II, Italy

2015: Research engineer - Scientist assistant at the Aristotle University of Thessaloniki, Greece.

2019-2022: Research Fellow at the 'Department of Civil Architectural and Environmental Engineering' of the University of Napoli Federico II.

2022 to date: Assistant Professor at the 'Department of Civil Architectural and Environmental Engineering' of the University of Napoli Federico II.

2020: National scientific qualification for Associate Professor - sector 08/B1 (Geotechnics)

Research

- Execution and interpretation of field and laboratory investigations on soil and foundations
- Probabilistic and deterministic seismic hazard analysis
- Seismic fragility and resilience of geotechnical systems
- 1D, 2D and 3D seismic response analyses for seismic microzonation
- Analysis of static and dynamic stability of rock cavities



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- Tests and analysis of soil-foundation-structure systems through simplified to advanced numerical models

On the above-mentioned research topics, she published more than 90 papers with a h-index = 14. She has been invited to give lessons in PhD courses at the national universities of Sannio, Genova, Napoli Federico II, and international university of London. She has been invited speaker at international conferences such as *SeismiCON 2020* and *SeismiCON 2023*.

Organizing activities

Organizing committee member of 3rd and 4th International Symposium on Geotechnical Eng. for the Preservation of Monuments and Historic Sites, respectively held in Napoli in 2022 and in Athens in 2026.

Convenor of the session 20 “Characterizing building's response: combined perspective from engineering and seismology for risk reduction” to the “3rd European Conference on Earthquake Engineering & Seismology”, Romania, 2022.

Convenor of the session 5 “Challenges in the seismic design of shallow foundations” to the “18th World Conference on Earthquake Engineering”, Italy, 2024.

Teaching

2022 to date: Lecturer of *Resilience of Geotechnical systems* (in English), M.Sc. degree in Transportation Engineering, University of Napoli Federico II (Italy).

2023: Lecturer of *Dynamic Soil-Structure Interaction: tests and methods of analysis*, PhD program in Structural Engineering, Geotechnics and Seismic Risk, University of Napoli Federico II (Italy).

2020 & 2022: Lecturer for Master course Geotechnics for infrastructures – Dynamic soil-structure interaction, University of Napoli Federico II (Italy).

2019–2021: Lecturer of *Fundamentals of Geotechnical Engineering*, B.Sc. degree in Civil Engineering, University of Napoli Federico II (Italy).

2019: Lecturer of *Soil Behavior & Soil-Structure Interaction in Seismic Conditions*, PhD program in Civil, Chemical & Environmental Engineering, University of Genova (Italy).

2018–2019: Lecturer of *Foundations and Retaining Structures*, M.Sc. degree in Civil Engineering, University of Genova (Italy).

Coordinator of international agreements with the University of Alberta (Canada)

Appointments and awards

-2018 *Outstanding Paper Award* from the journal *Earthquake Spectra*.



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-Selected by the Italian Geotechnical Association as national delegate to present the results of her PhD to the *26th International Conference of Young Geotechnical Engineers*.
-Co-supervisor of the M. Sc. thesis on SFSI of C. Amendola and M. Boccardi awarded twice in 2020 and 2021 with the *national prize on the seismic engineering* provided by the National Institutes OSG and CNR and dedicated to Marco Mucciarelli.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio

	Francesco Silvestri
<i>n. 3</i>	Giorgio Andrea Alleanza (34th cycle, ministerial grant), Francesco Gargiulo (35th cycle, ministerial grant), Juan Manuel Barbagelata (37th cycle, ministerial grant)
<i>n. 2</i>	Filomena de Silva Andrea Brunelli (34th cycle at University of Genoa, ministerial grant), Enza Zeolla (36th cycle at University of Sannio, ministerial grant)

3. Titolo della ricerca proposta

Effect of soil properties and subsurface cavities on the seismic performance and fragility of buildings

4. Area tematica

Ingegneria Geotecnica

Ingegneria Strutturale

Rischio Sismico (ma include anche le due precedenti)



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5. Tipologia di borsa per la quale si propone il progetto

Ateneo ■

DM 117 (Investimento 3.3) □
(in questo caso indicare l'azienda co-finanziatrice)

DM 118 (Investimento 4.1 P.A.) □

DM 118 (Investimento 4.1 generici) □

DM 118 (Investimento 4.1 Patrimonio culturale) ■

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

Earthquakes produce significant losses to urban historical centres, as many Italian experiences emblematically testified, increasing the risk of their depopulation with detrimental social/economic implications. Especially for old-fashioned masonry buildings, the high seismic risk often derives from the high degree of hazard and vulnerability, with both factors significantly influenced by soil and foundation properties. Typically, deformable soils amplify the reference seismic motion and modify the structural response, affecting both the foundation input motion and the performance of the above-ground structure. The complexity of the problem is enhanced by the fact that masonry structures were frequently built by using the rock material available on site. Such quarrying activities often originate underground cavities close the buildings, leading to peculiar soil-structure interaction phenomena under static and seismic actions.

In the current engineering practice, the seismic action and the structural response are evaluated separately through an uncoupled approach, in which the foundation input motion can be obtained by modifying the free-field motion, while the building performance is analyzed in fixed-base or compliant-base conditions. In such a case, the effect of a cavity on the amplitude and frequency content of the seismic motion can be considered by properly modifying the free-field motion, but the damage suffered by an overlying building due to cavity deformation and failure mechanisms can be overlooked.

The scope of this research program is to evaluate how the tools adopted in the risk assessment at urban scale, such as seismic microzonation maps (expressed in terms of amplification of suitable intensity measures) and structural fragility curves (relating the



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probability of damage to the intensity measure), can be modified in order to account for the effects of the soil-cavity-foundation-structure interaction.

The research program involves the following activity stages:

1. Selection of representative historical centers located in regions with moderate-to-high hazard, characterised by the widespread presence of cavities underneath the buildings.
2. Geometrical and mechanical characterization of the typical soil-cavity-foundation-structure systems.
3. Execution of linear and nonlinear dynamic analyses of numerical models including soil, cavity, foundation and structure. A sensitivity study will be performed by changing the geometrical and mechanical properties of the system components.
4. Interpretation of the results to generate charts in terms of dimensionless parameters controlling the intensity measure of the foundation input motion and the engineering demand parameters for structure and cavity.
5. Application of the charts to modify the intensity measure provided by the seismic microzonation maps and the probability of failure provided by standard fragility curves.
6. Simulation of seismic damage and calculation of the resilience index at urban scale for selected historical centers located in regions with moderate-to-high hazard.

7. Eventuali pubblicazioni dei tutor sul tema di ricerca (max 10)

- 1) Evangelista L., Landolfi L., d'Onofrio A., Silvestri F. (2016). *The influence of the 3D morphology and cavity network on the seismic response of Castelnuovo hill to the 2009 Abruzzo earthquake*. Bulletin of Earthquake Engineering, 14(12):3363–3387. doi:10.1007/s10518-016-0011-8
- 2) Alterio L., Russo G., Silvestri F. (2017). *Seismic vulnerability reduction for historical buildings with non-invasive subsoil treatments: the case study of the Mosaics Palace at Herculaneum*. International Journal of Architectural Heritage, 11(3):382–398, doi:10.1080/15583058.2016.1238969
- 3) de Silva F., Pitilakis D., Ceroni F., Sica S., Silvestri F. (2018). *Experimental and numerical dynamic identification of a historic masonry bell tower accounting for different types of interaction*. Soil Dynamics and Earthquake Engineering 109: 235–250, doi:10.1016/j.soildyn.2018.03.012
- 4) de Silva F., Ceroni F., Sica S., Silvestri F. (2018). *Non-linear analysis of the Carmine bell tower under seismic actions accounting for the soil-foundation-structure Interaction*. Bulletin of Earthquake Engineering 16(7):2775–2808 doi:10.1007/s10518-017-0298-0



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- 5) de Silva F., Scotto di Santolo A. (2018). *Probabilistic performance-based approaches to the static and seismic assessment of rock cavities*. International Journal of Rock Mechanics and Mining Sciences. 112: 354-368. <https://doi.org/10.1016/j.ijrmms.2018.10.028>
- 6) Piro A., de Silva F., Parisi F., Scotto di Santolo A., Silvestri F. (2019). *Effects of soil-foundation-structure interaction on fundamental frequency and radiation damping ratio of historical masonry building sub-structures*. Bulletin of Earthquake Engineering, 18:1187–1212, doi: 10.1007/s10518-019-00748-4.
- 7) de Silva F. (2020). *Influence of soil-structure interaction on the site-specific seismic demand of masonry towers*. Soil Dynamics and Earthquake Engineering, 131, 106023. <https://doi.org/10.1016/j.soildyn.2019.106023>
- 8) Brunelli A., de Silva F., Piro A., Parisi F., Sica S., Silvestri F., Cattari S. (2021). *Numerical simulation of the seismic response and soil–structure interaction for a monitored masonry school building damaged by the 2016 Central Italy earthquake*. Bulletin of Earthquake Engineering, 19:1181–1211 <https://doi.org/10.1007/s10518-020-00980-3>
- 9) Brunelli A., de Silva F., Cattari S. (2022). *Site effects and soil-foundation-structure interaction: derivation of fragility curves and comparison with codes-conforming approaches for a masonry school*. Soil Dynamics and Earthquake Engineering. 154, 107125. <https://doi.org/10.1016/j.soildyn.2021.107125>
- 10) de Silva F., Lusi T., Ruotolo M., Ramondini M., Flora A. (2023). *Reliability-based roof stability charts for cavities in heterogeneous jointed rock masses*. Rivista Italiana di Geotecnica, 2, 2023. [dx.doi.org/10.19199/2023.1.0557-1405.042](https://doi.org/10.19199/2023.1.0557-1405.042)

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

The research activity is associated with seismic risk assessment studies performed in the framework of the DPC-ReLUIIS 2022–2024 project (<https://www.reluis.it>), the RETURN (Multi-Risk sciEence for resilienT commUnities undeR a changiNg climate, <https://www.fondazionereturn.it/>) project and PRIN 2020 *GLANO - Geo-risks assessment and mitigation for the protection of cultural heritage*.

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



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The research activity will consist of numerical and experimental studies, which will be supported by the abovementioned research projects and additional funding for research mobility both inside and outside Europe.

10. 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 PhD student is expected to spend 6 months in a major university or research centre, such as:

- Aristotle University of Thessaloniki (Greece), in cooperation with Prof. Dimitris Pitolakis (DPitolakis@civil.auth.gr)
- University of Alberta (Canada), in cooperation with Prof. Lijun Deng (ldeng@ualberta.ca)

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

A fruitful interaction can be established with companies operating in the field of surveys, subsoil investigation and ground improvement, including the Spin-Off 'Terre Leggere' which develops innovative technologies using lightweight soil mixtures.

Napoli, 26/06/2023

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 **il 30/06/2023**.