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

XXXVII CICLO

I sottoscritti prof. Antonio Santo (PO □ PA ■ RU □ RTD □) e prof. Fulvio Parisi (PO □ PA □ RU □ RTD ■), rispettivamente afferenti al Dipartimento di Ingegneria Civile, Edile e Ambientale e al Dipartimento di Strutture per l'Ingegneria e l'Architettura per i S.S.D. GEO/05 Geologia Applicata e ICAR/09 Tecnica delle Costruzioni.

CHIEDONO

di essere inseriti nell'elenco dei tutor per il XXXVII ciclo.

1. Curriculum dei proponenti (max 500 parole)
Antonio Santo is Associate Professor of Engineering Geology since 2006. He was Researcher of Engineering Geology at Napoli University since 1991 till 2005. He had a teaching activity at Molise (1996-1998), Salerno (1999-2000) and SUN Universities (2004-2005). He was Scientific Coordinator of the preparatory course "Hydrogeological Territorial Defenses in Campania Region" for the National Civil Protection and Scientific Coordinator of Metropolis Project (2015-2017). He was Member of Campania Region Competence Centre on "Analysis and Monitoring of the Environmental Risk" since 2002. Actually, he is involved in the Reluis (2019-2021) Project (Department of Civil Protection) and GRISIS Project (2017-2020). He has been consultant of many national research agencies and authorities: CNR - GNDCI (Gruppo Nazionale Difesa Catastrofi Idrogeologiche) (1998-1999); C.U.G.R.I. (Inter - University Consortium for Great Risks forecast and prevention (1999-2000); Regione Campania "NW" Regional Authority (2001 - 2003)- Hydrogeological risk planning; Regione Campania "Sinistra Sele" Regional Authority (2001 - 2003) - Coastal erosion planning; Regione Campania "Sarno river" Regional Authority (2006)- Hydrogeological risk planning; AMRA - (2006 – 2008) Civil protection planning (landslide risk); Regione Campania "NW" Regional Authority (2007 - 2008)- Hydrogeological risk planning Government Commissary (2007-2008) – Landslide risk mitigation in the Sarno municipality. He has nearly 30 years' research experience in Engineering Geology, slope instability, rapid flow slides, landslide susceptibility evaluation and mapping, slope instability in karst areas, sinkholes and alluvial fan flooding. The main results are published on international scientific journals, as: Engineering Geology, Landslides, Natural Hazards, Geomorphology, Zeitschrift fur Geomorphologie, Quaternary

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International, Acta Carsologica, Natural Hazard and Earth System Science, Earth Surface Processes and Landforms, Earthquake Spectra, Soil Dynamics and Earthquake Engineering.

Fulvio Parisi is Assistant Professor (with tenure track) in Structural Engineering at University of Naples Federico II, Italy, and Associate Researcher of the National Research Council of Italy (CNR). In 2017, he received the Italian national scientific qualification as Associate Professor in Structural Engineering.

He teaches the courses entitled "Design and Retrofit of Masonry Structures" and "Diagnosis and Therapy of Structural Failures", giving many invited lectures in different universities and research centres across Europe and USA. He is a Scientific Board Member and teacher of "Structural Failures and Collapses" in the post-graduate MSc Programme in Forensic Engineering. Since 2018, he is expert reviewer of the Italian Ministry for University and Research.

He is Associate Editor of 3 international journals and Editorial Board member of 2 international journals. In almost 20 research projects, his research mainly focused on assessment, retrofitting, robustness, and health monitoring of existing structures.

He authored more than 135 papers in peer-reviewed journals and conference proceedings, 1 book, 10 book chapters, 30 reports, and 3 computer tools for seismic analysis of masonry buildings and experimental data selection of masonry properties. He edited 2 books and 2 journal special issues. His research outcomes were awarded or recognized by several institutions and journals, with some studies implemented or cited in guidelines published by the American Concrete Institute and CNR.

He was a scientific or organizing committee member of more than 15 international conferences, and coordinator or member of working groups in several associations and standard bodies, such as Fédération Internationale du Béton (fib), CNR, Comité Européen de Normalisation (CEN), and Ente Nazionale di Normazione (UNI).

In 2019, he founded the spin-off company FORENSICS srl (FORensic ENgineering ServICeS), where he is Head of Civil and Risk Engineering services.

In 2020, he was included in the list of World's Top 2% Scientists according to the scientific impact of his research activity.

2. Dottorandi dei quali i proponenti sono stati tutor nell'ultimo triennio	
n. 4	Annachiara Piro (33rd cycle, graduated in 2021)
	Martina Scalvenzi (34th cycle, ministerial grant)

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	Giacomo Miluccio (35th cycle, grant funded by research project)
	Francesco Gargiulo (35th cycle, ministerial grant)

3. Titolo della ricerca proposta
Multi-hazard landslide risk assessment of buildings

4. Area Tematica
Ingegneria Geotecnica □   Ingegneria Strutturale □   Rischio Sismico ■

5. Sintesi del progetto di ricerca (max 500 parole. Stato dell'arte, breve programma previsto per le attività e obiettivi)
Landslide risk assessment is a key challenge for modern society. Every year landslides occur all over the world, causing fatalities and heavy damage to buildings and infrastructure systems. Landslides are triggered by the occurrence of either natural hazards (e.g., earthquakes, heavy rainfalls, volcanic eruptions) or anthropogenic hazards (e.g., excavations, mining activities). Nevertheless, landslides induced by earthquakes and rainfalls provide the main contribution to landslide hazard in many countries.   The protection of the built environment against landslides is a key goal for sustainable development of society, allowing a substantial reduction of disaster losses. In this respect, the Sendai Framework for Disaster Risk Reduction 2015–2030 calls for a paradigm shift from "disaster management" to "disaster risk management" against multiple hazards. Therefore, a multi-hazard probabilistic framework for landslide risk assessment of constructions is required, going beyond classical land management schemes based only on landslide susceptibility maps. Apart from few recent studies within research projects on landslide risk, there is the need for comprehensive multidisciplinary methodologies that starts from geological models, moving to a quantitative vulnerability analysis of structures and loss assessment.

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The **goal** of this PhD project is to implement the performance-based engineering framework formulated by the Pacific Earthquake Engineering Research (PEER) Center to the multi-hazard risk assessment of buildings located in landslide-prone areas. The PEER framework is extensively applied to earthquake engineering, however receiving limited attention in landslide risk assessment so far. More specifically, this PhD project will focus on risk assessment of buildings to landslides triggered by earthquakes or heavy rainfalls. Special attention will be given to slow-moving landslides and flow-type landslides, which typically produce heavy damage to buildings located on the crest of slopes or at slope toes.

The research activity will consist of the following **tasks**:

1) Data collection on past landslides occurred in Italy (e.g., after the 2016-2017 Central Italy earthquakes) and other countries.
2) Identification of case studies for site-specific analyses of landslides and their impact on existing buildings.
3) Definition of slope and building archetypes, based on their geomorphological, geotechnical, and structural characteristics, the latter based on state-of-the-art exposure models for Italy and/or Europe.
4) Selection of probabilistic models for mechanisms that regulate landslide initiation and run-out (travel distance), accounting for topography, geology, soils, hydrology, and anthropogenic factors.
5) Derivation of typological vulnerability models through computationally efficient methods of structural modelling and response analysis in extreme conditions (including progressive collapse mechanisms), using software packages for mathematical programming (e.g., Matlab, Python) and structural analysis (e.g., OpenSees).
6) Estimation of losses by means of consequence functions, providing the impact of future landslides in terms of, e.g., casualties, homeless, and economic losses.
7) Derivation of multi-hazard landslide risk maps, which might be effectively combined with other risk maps to compute disaster risk at regional or national scale.

6. Pubblicazioni sul tema di ricerca

Brunesi E., Nascimbene R., Parisi F., Augenti N. (2015). Progressive collapse fragility of reinforced concrete framed structures through incremental dynamic analysis. *Engineering Structures*, 104:65-79.

Brunesi E., Parisi F. (2017). Progressive collapse fragility models of European reinforced concrete framed buildings based on pushdown analysis. *Engineering Structures*, 152:579-596.

Di Maio R., De Paola C., Forte G., Piegari E., Pirone M., Santo A., Urciuoli G. (2020).

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An integrated geological, geotechnical and geophysical approach to identify predisposing factors for flowslide occurrence. *Engineering Geology*, 267.

Forte G., Pirone M., Santo A., Nicotera M.V., Urciuoli G. (2019). Triggering and predisposing factors for flow-like landslides in pyroclastic soils: The case study of the Lattari Mountains (southern Italy). *Engineering Geology*, 257C.

Miluccio G., Parisi F., Cosenza E. (2020). Impact of cumulative damage on fragility of RC framed buildings subjected to earthquake-induced landslides. In: M. Papadrakakis, M. Fragiadakis, C. Papadimitriou (editors). *EURODYN 2020 – XI International Conference on Structural Dynamics*, Athens, Greece, 22-24 June 2020.

Mucedero G., Brunesi E., Parisi F. (2020). Nonlinear material modelling for fibre-based progressive collapse analysis of RC framed buildings. *Engineering Failure Analysis*, 118:104901.

Parisi F., Sabella G. (2017). Flow-type landslide fragility of reinforced concrete framed buildings. *Engineering Structures*, 131:28-43.

Picarelli L., Olivares L., Damiano E., Darban R., Santo A. (2020). The effects of extreme precipitations on landslide hazard in the pyroclastic deposits of Campania Region: A review. *Landslides*, 17(10):2343-2358.

Santo A., Di Crescenzo G., Forte G., Papa R., Pirone M., Urciuoli G. (2018). Flow-type landslides in pyroclastic soils on flysch bedrock in southern Italy: The Bosco de' Preti case study. *Landslides*, 15:63-82.

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

The research activity is connected to a number of numerical investigations, which are underway within the following research projects: ReLUIS-DPC 2019–2021 (WP4: Risk Maps and Seismic Damage Scenarios); PON INSIST "Smart monitoring system for safety of urban infrastructure"; PON GRISIS "Risk management and safety of infrastructures at regional scale". However, other projects could be funded on the topic.

8. Fondi disponibili per eventuali assegni, borse di ricerca, ecc., per acquisto eventuale di attrezzature, missioni

The research activity will mainly consist of numerical research, which is supported by the above-mentioned research projects. Such projects also provide funding for grants and missions to attend meetings, workshops and conferences.

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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*) (max 300 parole)

The PhD student is expected to spend at least 6 months in one or more of the following research institutions:

- University of Lausanne (Switzerland) under supervision of Prof. Michel Jaboyedoff (Michel.Jaboyedoff@unil.ch), who is Professor of Engineering Geology in the Risk Group of the Institute of Earth Sciences and was involved in many research projects such as the FP7 European project SafeLand "Living with landslide risk in Europe: Assessment, effects of global change and risk management strategies".

- University College London (UK) under supervision of Prof. Dina D'Ayala (d.dayala@ucl.ac.uk), who is Professor of Structural Engineering in the Department of Civil, Environmental and Geomatic Engineering, Co-Director of the Earthquake and People Interaction Centre (EPICentre), and Director of the International Association for Earthquake Engineering (IAEE), with long experience on multi-hazard assessment, strengthening, preservation and resilience of existing buildings.

- University of Porto (Portugal) under supervision of Prof. Humberto Varum (hvarum@fe.up.pt), who is Professor of Structural Engineering with expertise in experimental testing, nonlinear response analysis, and innovative retrofitting of building structures.

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

The research activity might stimulate cooperation with several companies that work in the field of multi-hazard risk assessment as well as land and structural health monitoring, such as ARUP and Tecno-In Geosolutions.

Napoli, 30/04/2021   FIRMA

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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 30/04/2020**.