



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. **Emilio BILOTTA**

(PO PA **X** RU RTD) afferente al **Dipartimento di Ingegneria Civile, Edile e Ambientale (DICEA) S.S.D. ICAR/07 – Geotecnica**

CHIEDE

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

1. Curriculum sintetico del proponente (max 500 parole)

Born in 1975

Education

- **2004: PhD** in Geotechnical Engineering, University Sapienza of Rome (Italy)
- **1999: 5-year Master Degree (Laurea)** in Civil Engineering (marks: 110/110 cum laude), University of Napoli Federico II (Italy)
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Current academic position

- **2016 to date: Associate Professor** (Geotechnical Engineering) at University of Napoli Federico II

Career

2017, Dec **National Scientific Qualification (ASN)** for recruitment in a position of full professor

2016, Nov **Visiting Scholar** at Department of Geotechnical and Tunnel Engineering of Shanghai Tongji University (China)

2010-2016 **Tenured Researcher** and **Adjunct Professor** at University of Napoli Federico II

2008-2010 **Research Associate** at Dept. of Hydraulic, Geotechnical and Environmental Engineering - University of Napoli Federico II

2007 **Researcher** at CMCC (Euro-Mediterranean Centre for Climate Changes) of Lecce

2006 **Visiting Research Fellow** at School of Engineering and Mathematical Sciences, City University London (UK)

2004-2006 **Post-Doctoral Scholar** at Dept. of Geotechnical Engineering - University of Napoli Federico II

2002 **Visiting Research Student** at the Geotechnical Engineering Research Centre, City University London (UK)

2000-2003 **PhD Student** in Geotechnical Engineering, University Sapienza of Rome

2000 **Research Trainee** at INP (Institut National Polytechnique), Grenoble, France.



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Teaching:

- **Soil mechanics** (undergraduate)
- **Tunnels and underground structures** (post-graduate).

Research (main topics):

- **Tunnels in urban areas**
- **Ground improvement for mitigation against soil liquefaction**
- **Ground improvement for seismic isolation of buildings and infrastructures**
- **Geotechnical engineering for the preservation of monument and historic sites**

Co-author of more than 120 scientific papers, 35 of them on indexed international Journals (ORCID 0000-0002-3185-2738).

Editorial Board Member of *Rivista Italiana di Geotecnica*, *Gallerie* and *Frontiers in Built Environment*

Guest Editor of a special issue of *Acta Geotechnica* (Aug 2014);

Co-editor of the Proceedings of International Symposium *Geotechnical Engineering for the Preservation of Monuments and Historic Sites*, Balkema

Co-editor of the volume *Geotechnics and Heritage*, Balkema

Member of the **Scientific Committee** of the *Handbook on Tunnels and Underground Works* (3 volumes, to be published in 2021-22)

Member of **Italian Geotechnical Association (AGI)** and **International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE)**

Member of **Società Italiana Gallerie (SIG)**

Italian delegate of **Technical Committees TC 104** (*Physical Modelling*) and **TC 219** (*System Performance of Geotechnical Structures*) of the ISSMGE

Member of the **European Commitment on Raw Materials "ROSE - Recycling of secondary raw materials for a sustainable optimization of construction processes in civil engineering works"**, (<https://ec.europa.eu/eip/raw-materials/en/commitment-detail/344>)

Activities of research-academia-business cooperation and knowledge transfer

- **2020** co-founder of the Academic Spin-off and Start-up *Smart-G - innovative solutions in ground improvement and geotechnical engineering* (www.smart-g.eu)
- **2018** patent for industrial invention "*Procedure to limit the propagation of vibrations in the ground*" at the Italian Ministry of Economic Development (No. 102016000044134).
- **2016-2019** European H2020-LIQUEFACT RIA project (GA no. 700748) (budget UNINA approx. 600 k€), www.liquefact.eu.
- **2015-16** knowledge transfer project "*TICISI - Columnary Treatments for Seismic and Hydraulic Insulation*" (industrial partner: Tecno-IN SpA) within the POR Campania funding scheme, DICEA budget approx. 150 k€).
- **2013-2016** National Research and Competitiveness project METRICS (*Methods and Technologies for the management and re-qualification of Historic Centers and prestigious buildings*), coordinated by the industrial partner Stress s.c.ar.l. DICEA budget approx. 150 k€).



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

<i>n. 6</i>	<p><i>specificare tipologia di borsa: ateneo, pon, por, senza borsa, ecc.</i></p> <ol style="list-style-type: none"> 1. Stefania Fabozzi (2017), “Behaviour of segmental tunnel lining under static and dynamic loads”, XXIX ciclo, Dottorato DISGERS, co-tutore con Aldo Zollo, borsa di Ateneo 2. Valeria Nappa (2017), “Soft grouting for seismic isolation” XXX ciclo, Dottorato DISGERS, co-tutore con Alessandro Flora, borsa di Ateneo 3. Gianluca Fasano (2020), “Experimental and numerical investigation of the effectiveness of some innovative techniques to mitigate liquefaction risk”, XXXII ciclo, Dottorato DISGERS, co-tutore con Alessandro Flora, borsa finanziata dal progetto H2020 - LIQUEFACT 4. Zhiming Zhang (2020), “Shaking-table tests and numerical simulations of seismic failure of atrium-style metro stations”, XXXII ciclo, Dottorato Ingegneria dei Sistemi Civili (DICEA), tesi in co-tutela con Tongji University, co-tutore con Yong Yuan, borsa finanziata dal China Scholarship Council. 5. Jinghua Zhang (2021), “Seismic analysis of the critical parts in shield tunnels”, XXXIII ciclo, Dottorato Ingegneria dei Sistemi Civili (DICEA), tesi in co-tutela con Tongji University, co-tutore con Yong Yuan, borsa finanziata dal China Scholarship Council. 6. Giuseppe Astuto (2021), “Sviluppo di una tecnologia di parziale saturazione indotta per la mitigazione del rischio liquefazione” XXXIII ciclo, Dottorato DISGERS, co-tutore con Alessandro Flora, borsa finanziata dal PON-MIUR Dottorato Industriale.
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3. Titolo della ricerca proposta

Soil-structure interaction on liquefiable soils and effects on built environment

4. Area tematica

Ingegneria Geotecnica

Ingegneria Strutturale

Rischio Sismico



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

The research deals with the soil-structure interaction between a liquefiable ground and buildings, focusing not only on liquefaction triggering, but on the antecedent pore pressure build-up during shaking and possible critical mechanisms (i.e. loss of bearing capacity, excessive settlement...) that may arise as its consequence.

Although several numerical studies have been carried out on such a topic (e.g. Shahir and Pak, 2010; Karamitros et al., 2013; Ayoubi & Pak, 2017), only a few experimental evidences are available to validate the numerical results, most of them from reduced scale models in centrifuge (e.g. Karimi and Dashti, 2016; Hughes and Madabhushi, 2019), due to the lack of complete datasets from real cases.

Previous studies have also shown that proximity among buildings in urban areas can affect ground motions, hence pore pressure build-up, induced settlement and potential damage (e.g. Jafarian et al., 2017). Hence the need to better understand building-soil-building interaction in liquefiable ground and the relevant controlling parameters. This would enable new strategies of ground improvement design thus contributing to the resilience of urban environment against earthquake-induced soil liquefaction.

A common measurement of the level of pore pressure build-up is the excess pore pressure ratio, r_u , that may be predicted with simplified assessment procedures in *free-field* conditions. Such calculations enable a reliable assessment of the effective stresses in *free-field* during shaking. However, it is well known that beneath the building foundations different distributions of excess pore pressure, hence of r_u , may develop, due to the different stress level compared to the *free-field*. Therefore, predicting the associated settlements and possible bearing capacity reduction from *free-field* r_u is not straightforward. Aim of the research is to verify if r_u can be a good predictor of the foundation settlement, before and after liquefaction occurs.

Both numerical and physical modelling will be adopted to investigate the problem, following the same approach already adopted in previous research projects (Fig. 1).

Two centrifuge tests will be carried out on a reduced scale model of a building founded on shallow foundation, with the aim of measuring the excess pore pressures that develop in the ground as well as the ground and building settlements during a seismic shaking. A first test will be carried out with a single building, while in a second the presence of adjacent building will be simulated. The dynamic response of the soil layer and of the building will be also measured, in terms of acceleration time histories and spectra. The results will be used to calibrate the numerical models through which the study will be expanded to different conditions.



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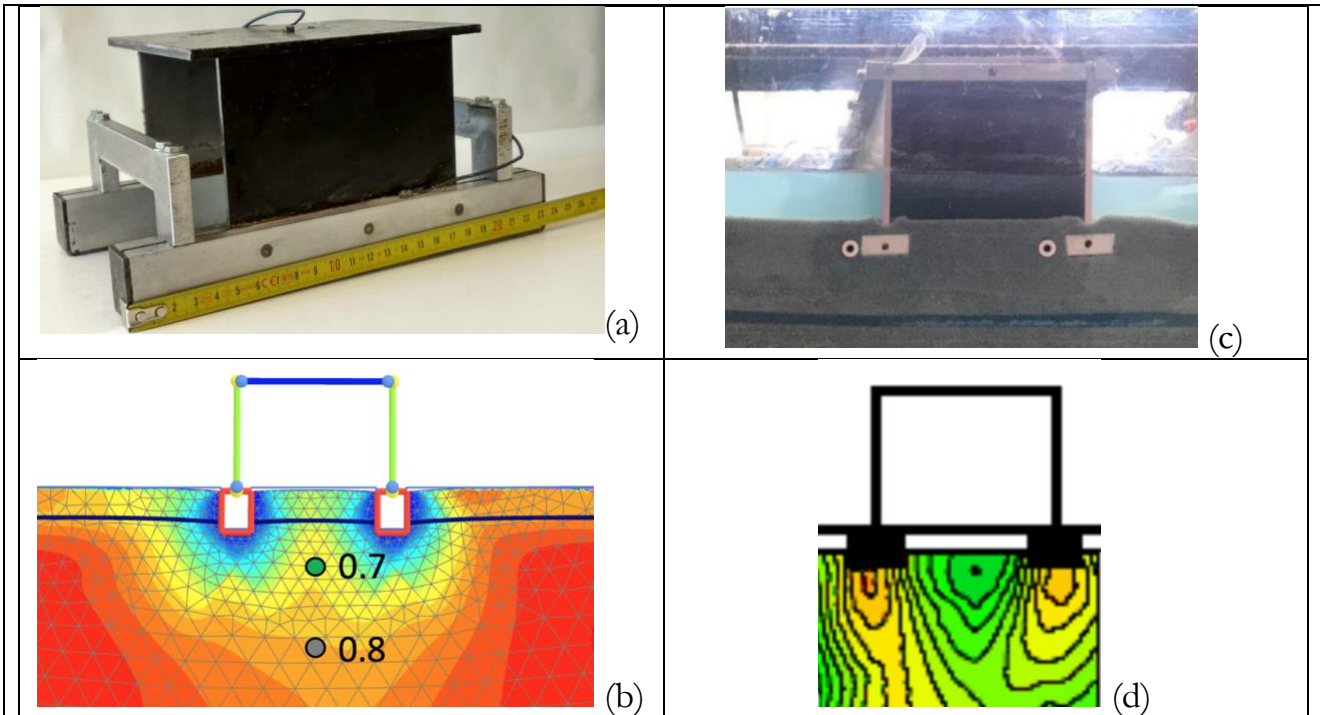


Figure 1 Reduced scale models of building in liquefiable soil: (a) building model in centrifuge tests of LIQUEFACT project; (b) numerical results vs. centrifuge measurements of excess pore pressure ratio in a LIQUEFACT test; (c) building model in a centrifuge test of STILUS-SERA project; contours of ground displacements measured by Particle Image Velocimetry in a STILUS-SERA test

(a,b from Fasano, 2020; c,d from Bilotta et al. (2020))

The main objectives of the research will be pursued as follows.

- During the first year the PhD student will:
 - investigate the problem by numerical analysis: existing and significant case histories from literature will be analyzed;
 - identify the relevant influencing factors.
- During the second year, the student will:
 - plan the centrifuge tests to be carried out at the *Center for Infrastructure, Energy, and Space Testing* of the University of Boulder, Colorado (USA);
 - carry out the centrifuge tests. The layout of tests (in particular the ground conditions and the structural layout) will be defined based on the results achieved in the first year.
- During the third and last year, a set of numerical analyses will be carried out to:
 - validate the numerical models against the centrifuge tests;
 - extend the scope of the study, using the validated numerical models.



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

- 1) Chiaradonna A., Flora A., d'Onofrio A., **Bilotta E.** (2020). "A pore water pressure model calibration based on in-situ test results". *Soils and foundations* (in press)
- 2) Di Ludovico M., Chiaradonna A., **Bilotta E.**, Flora A., Protta A. (2020). "Empirical damage and liquefaction fragility curves from 2012 Emilia earthquake data". *Earthquake Spectra*. 36 (2).
- 3) Miranda G., **Bilotta E.**, Nappa V., Haigh S.K., Madabhushi S.P.G. (2020). "Centrifuge tests on tunnel-building interaction in liquefiable soil". *Proc. 10th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground – IS Cambridge 2020*. CRC Press (in press).
- 4) Fasano G., Chiaradonna A., **Bilotta E.** (2020) LEAP-UCD-2017 Centrifuge Test Simulation at UNINA, in B. Kutter et al. (eds.), *Model Tests and Numerical Simulations of Liquefaction and Lateral Spreading*, Springer, ch. 22 441-459
- 5) Chiaradonna, A., d'Onofrio, A., **Bilotta, E.** (2019). Assessment of post-liquefaction consolidation settlement. *Bulletin of Earthquake Engineering*.
- 6) **Bilotta E.**, Chiaradonna A., Fasano G., Flora A., Mele L., Nappa V., Lirer S. (2019) "Experimental evidences of the effectiveness of some liquefaction mitigation measures". *Proc. IABSE Symposium 2019 Guimaraães Towards a Resilient Built Environment - Risk and Asset Management March 27-29, 2019, Guimaraães, Portugal*
- 7) Fasano, G., De Sarno, D., **Bilotta, E.**, Flora, A. (2019). Design of horizontal drains for the mitigation of liquefaction risk. *Soils and Foundations*.
- 8) Fioravante V., Giretti D., Moglie J., **Bilotta E.**, Fasano G., Flora A., Nappa V. (2019) Centrifuge modelling of soil-structure interaction in liquefiable ground before and after the application of remediation techniques. *Proc. of VII International Conference on Earthquake Geotechnical Engineering 7ICEGE 2019, 17-20 June Roma (Italy)*.
- 9) Fasano G., **E. Bilotta**, A. Flora, V. Fioravante, D. Giretti, C.G. Lai, A.G. Özcebe (2018). Dynamic centrifuge testing to assess liquefaction potential. *Proc. 9th International Conference on Physical Modelling in Geotechnics, Londra (UK)*.
- 10) Chiaradonna A., **E. Bilotta**, A. d'Onofrio, A. Flora, F. Silvestri (2018). A simplified procedure for evaluating post-seismic settlements in liquefiable soils. *Proc. of the 5th Geotechnical Earthquake Engineering and Soil Dynamic, GEESD 2018, Austin, Texas (USA), 2018*.

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

Al momento l'attività di ricerca non è finanziata da fondi esterni ma s'inquadra nell'ambito delle attività che il tutor ha in corso da alcuni anni sulla mitigazione del rischio liquefazione, condotta principalmente nell'ambito del progetto H2020 LIQUEFACT (700748 - *Assessment and mitigation of liquefaction potential across Europe: a holistic approach to protect structures/infrastructures for improved resilience to earthquake-induced liquefaction disasters*, da poco concluso) e del progetto STILUS, condotto nell'ambito della rete SERA-TA (730900 - *Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe*).



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

Il tutor è responsabile dell'accordo interdipartimentale tra il DICEA di Federico II e il *Center for Infrastructure, Energy, and Space Testing* (CIEST) di Boulder Colorado, nell'ambito del più ampio Accordo di Ateneo di Collaborazione scientifica tra l'Università del Colorado a Boulder (USA) e l'Università di Napoli Federico II.

Al fine di facilitare la mobilità del dottorando e dei tutor da e verso Boulder, Colorado s'intende fare richiesta di accesso a fondi di Ateneo che finanzino attività di ricerca nell'ambito di accordi di cooperazione internazionale.

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)

Le prove in centrifuga saranno svolte presso il *Center for Infrastructure, Energy, and Space Testing* dell'**Università di Boulder Colorado (USA)**. E' previsto un soggiorno di **3-4 mesi**. Il riferimento è:

Shideh Dashti

Associate Professor in Geotechnical Engineering & Geomechanics

e-mail: shideh.dashti@colorado.edu

Il *Center for Infrastructure, Energy, and Space Testing* (CIEST) è un gruppo di laboratori condivisi, aperti a studenti, docenti e visitatori, che fornisce un'infrastruttura sperimentale costituita da tre centrifughe geotecniche, attrezzature per dinamica strutturale e prove sui materiali.

Durante il suo soggiorno a Boulder, lo studente potrà condurre due prove in centrifuga su modello di edificio in terreno liquefacibile, in due diverse condizioni stratigrafiche, con il fine di misurare lo sviluppo di sovra-pressioni neutre e i cedimenti indotti a piano campagna e alla struttura durante lo scuotimento sismico. I risultati delle prove saranno utili a calibrare i modelli numerici sulla base dei quali il problema sarà esteso a condizioni diverse da quelle modellate in centrifuga.



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

Al momento non sono previste collaborazioni con aziende.

Napoli, 10.02.2020

FIRMA

A handwritten signature in black ink, appearing to read "Emilio Fubla".

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**.