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. Alessandro Flora

(PO X PA □ RU □ RTD □) afferente al Dipartimento di Ingegneria Civile, Edile e Ambientale

S.S.D. (*indicare codice e nome per esteso 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)

Alessandro Flora graduated at the University of Napoli Federico II and obtained his Ph.D. in Geotechnical Engineering from the Universities of Roma La Sapienza.
He joined the geotechnical group of the University of Napoli Federico II in 2000 as a researcher, becoming associate professor in 2005. He is now full professor at the Department of Civil, Architectural and Environmental Engineering (DICEA), teaching for Master course students the courses of 'Ground Improvement' and 'Geotechnical Works'.
He has been visiting researcher at the Institute of Industrial Science of the University of Tokyo (Japan) in 1994, and visiting professor at the University of Rio Grande do Sul (Brazil) in 2008.
He is secretary of the Technical Committee 301 (Preservation of Monuments and Historic Sites) of ISSMGE (International Society of Soil Mechanics and Geotechnical Engineering), and Italian representative of ISSMGE Technical Committee 211 (Ground Improvement). He is invited expert member of the "European Innovation Partnership (EIP) on Raw Materials" of the European Community. He has been member of the board of the Italian Geotechnical Association (AGI) from 2012 to 2019. He is coordinator of the AGI committee for the National Guidelines on Ground Improvement Technics. He has been Secretary of the Evolution Group EG14 (Ground Improvement) of TC250/SC7 (Eurocode 7 Committee) from 2012 to 2016.
He is member of the editorial board of: 1. RIG (Italian Geotechnical Journal); 2. Case Histories Journal of ISSMGE; 3. Built Heritage and Geotechnics Volumes, CRC Press/Balkema.
He is author of 2 books on jet grouting and co-editor of three books on Geotechnics and Heritage. He is co-author with R. Lancellotta and C. Viggiani of the Chapter on Foundations in the Encyclopedia of Engineering Geology, Encyclopedia of Earth Sciences Series, Springer (2018).
He has written about 200 scientific papers published on the main international geotechnical journals or presented at Conferences. In 2012 he has been awarded with the "Best Paper Award" from the Australian Research Council - Centre of Excellence for Geotechnical Science and Engineering.
He has been invited, keynote or state of the art speaker on different geotechnical topics related to his

research activities to many international conferences.
His main interests are related to ground improvement technologies, to the monotonic and cyclic behaviour of granular soils, to geotechnical seismic isolation, to liquefaction risk mitigation and to the role of geotechnical engineering in the preservation of monuments and historic sites.
He is Coordinator of the European Commitment on Recycling of Raw Materials (ROSE), and has been collector of different competitive Italian and European funding grants.
In the period 2015-2019 he has been one of the leaders of a 5.5 million euros European Project (H2020) on innovative liquefaction mitigation technologies (LIQUEFACT).
He is coordinator of funded scientific agreements between his Department (Civil, Architectural and Environmental Engineering) and the following research Institutions: University of Tokyo (Japan) (Japanese responsible prof. Koseki), QuakeCore Centre (New Zeland) (New Zeland responsible prof. Cubrinovski), University of Porto (Portugal) (Portuguese responsible prof. Viana da Fonseca), NORSAR (Norway) (Responsible Dr. Eng. Meslem), NGI (Norway) (Norvegian responsible Dr. Eng. Lang). Since 2018 he is one of the owners of the patent for industrial invention: "Procedure to limit the propagation of vibrations in the ground" at the Italian Ministry of Economic Development (No. 102016000044134).

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

n. 7	**Alessandro Flora** *specificare tipologia di borsa: ateneo, pon, por, senza borsa, ecc.* • Fausto Somma, borsa PON (dottorato in Ingegneria Strutturale, Geotecnica e Rischio Sismico, co-tutore E. Bilotta). • Giuseppe Astuto, borsa finanziata dal PON-MIUR Dottorato Industriale (dottorato in Ingegneria Strutturale, Geotecnica e Rischio Sismico, co-tutore E. Bilotta). • Gianluca Fasano, borsa finanziata da progetto di ricerca H2020 - LIQUEFACT (dottorato in Ingegneria Strutturale, Geotecnica e Rischio Sismico, co-tutore E. Bilotta). • Roberta Ventini, borsa di Ateneo (dottorato in Ingegneria Strutturale, Geotecnica e Rischio Sismico, co-tutore C. Mancuso). • Valeria Nappa, borsa di Ateneo (dottorato in Ingegneria Strutturale, Geotecnica e Rischio Sismico, co-tutore E. Bilotta). • Sara Gargano, borsa finanziata da progetto di ricerca H2020 – LIQUEFACT (dottorato in Ingegneria dei Sistemi Civili). • Lucia Mele, borsa finanziata da progetto di ricerca H2020 - LIQUEFACT (dottorato in Ingegneria dei Sistemi Civili).

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3. Titolo della ricerca proposta

New criteria to assess seismic liquefaction risk and to plan mitigation actions

4. Area tematica

Ingegneria Geotecnica **X**

Ingegneria Strutturale □

Rischio Sismico □

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

There is a large evidence worldwide that liquefaction may cause dramatic effects to built environments (e.g. New Zeland 2011, Emilia Romagna 2012). It is a peculiar mechanism that may take place in loose and saturated sandy deposits, temporarily inducing a phase transformation in the soil from a granular material to a fluid. Because of this, an almost complete temporary loss of shear strength and stiffness take place into the soil, causing extreme damages. Where liquefaction takes place, the damage it causes to structures largely overcomes the effects on them of inertial forces (e.g. Di Ludovico et al., 2020), also because the liquefied soil acts as a natural isolator, cutting most of the seismic energy transmitted through the soil. Because of this, there is an increasing attention in the scientific community to study the triggering conditions as well as the mechanisms that take place into the soil to end up with liquefaction. Italian code (NTC_2018) and Eurocodes (EC_8) explicitly ask for a check of the safety conditions with reference to liquefaction. However, the current practice, as reflected also by codes' indications, is still unable to take into account important aspects of liquefaction, thus resulting into a poor prediction of the true safety conditions. Typically, both capacity and demand are computed with reference to the so-called "stress based approach" proposed in the '70s by Seed, Idriss and coauthors in Berkeley. This is a simplified historical-empirical procedure that has become popular because of its simplicity, but has proven in many cases oversimplified and sometimes non conservative. The most critical drawbacks are the inability to consider "system response" (i.e. the hydraulic flow interaction between contiguous layers) and the inability to warn about critical mechanisms that may take place before full liquefaction is attained (bearing capacity failure or excessive settlements caused by the reduction of effective stresses).

The research proposed to the student aims to overcome some of this limitations, working on a new

approach to quantify soil response to seismic shaking. In particular, an energetic approach will be adopted, continuing the research activities demonstrated by some of the papers reported herein. The research will be carried out in close connection with groups with which we have started to cooperate abroad (University of Canterbury, New Zeland, University of California at Davis, USA, University of Porto, Portugal, University of Tokyo. Japan) and in Italy through the EU H2020 project LIQUEFACT. By finding a mechanically sound way to quantify the deviatoric and volumetric energy components (the latter only for unsaturated soils) needed to reach liquefaction for a given seismic action, the true safety conditions with reference to full fluidification but also to other mechanisms that may be triggered before it will be quantified. By so doing, not only the soil but the soil-structure system will be considered. This new approach should on one side allow to overcome the oversimplified (and possibly non conservative) indications of codes, and also become a rational tool to design mitigation actions through ground improvement techniques that modify some of the factors affecting soil liquefaction capacity. The activity will be theoretical and experimental (laboratory and centrifuge).

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

1. Flora A., Bilotta E., Chiaradonna A., Lirer S., Mele L., Pingue L. (2020). A field trial to test the efficiency of induced partial saturation and horizontal drains to mitigate the susceptibility of soils to liquefaction. Bullettin of Earthquake Engineering (in press).
2. Mele L. Chiaradonna A. Lirer S. Flora A. (2020). A robust empirical model to estimate earthquake-induced excess pore water pressure in saturated and unsaturated soils. Bullettin of Earthquake Engineering (under review).
3. Chiaradonna A. and Flora A. (2020). On the estimate of seismically-induced pore water pressure increments before liquefaction. Geotechnique Letters, Vol. 10, Issue 2, 1-7, https://doi.org/10,1680/jgele.19.00032.
4. 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).
5. Mele L., Lirer S., Flora A. (2019). The specific deviatoric energy to liquefaction in saturated cyclic triaxial tests. Proc. of the 7th Int. Conference on Earthquake Geotechnical Engineering (ICEGE 2019), Roma, 17-20 giugno 2019.
6. Mele, L., Lirer, S. & Flora, A. (2019). A liquefaction surface to describe liquefaction phenomena in unsaturated sandy soils. Proc. of the 7th Int. Conference on Earthquake Geotechnical Engineering (ICEGE 2019), Roma, 17-20 giugno 2019.
7. Mele L., Flora A. (2019). On the prediction of liquefaction resistance of unsaturated sands. Soil Dynamics and Earthquake Engineering. https://doi.org/10,1016/j.soildyn.2019.05.028
8. Mele L., Tan Tian J., Lirer S., Flora A., Koseki J. (2019). Liquefaction resistance of unsaturated sands: experimental evidences and theoretical interpretation. Geotechnique, https://doi.org/10.1680/jgeot.18.P.042, Vol. 69, No. 6, 541-553
9. Fasano, G., De Sarno, D., Bilotta, E. & Flora, A. (2019). Horizontal drains for the mitigation of liquefaction risk: design charts and experimental evidence. Soils and Foundations. https://doi.org/10,1016/j.sandf.2019.07.004.
10. Fasano G., Bilotta E., Flora A., Fioravante V., Giretti D., Lai C.G. and Özcebe A.G. (2018).

Dynamic centrifuge testing to assess liquefaction potential. Physical Modelling in Geotechnics, Proc. 9th Int. Conf. on Physical Modelling in Geotechnics (ICPMG 2018), July 17-20, London, United Kingdom, Volume 2, 955-960.

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) di cui è stato uno dei coordinatori scientifici nonché responsabile di unità di ricerca.

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

Fondi del progetto "Città Resilienti", sezione geotecnica (CIRES_GEO) coordinata da Alessandro Flora

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)

- L'attività di ricerca proposta si inquadra in una più ampia collaborazione tra lo scrivente e alcune prestigiose istituzioni internazionali (University of Canterbury, New Zeland, University of California at Davis, USA, University of Porto, Portugal, University of Tokyo. Japan) e nazionali. Il dottorando svolgerà quindi attività all'estero in uno o più di questi centri di ricerca stranieri, per un periodo previsto di circa 6-9 mesi. In particolare, le prove in centrifuga saranno svolte a Davis, dotata di una centrifuga molto avanzata e adatta al tipo di prove che si intende svolgere, mentre si prevede un periodo di permanenza anche a Christchurch, dove il gruppo di ricerca locale ha accumulato un'enorme quantità di dati sperimentali relativi alla sequenza sismica 2010-2011 e ai suoi effetti in termini di liquefazione, la cui analisi sarà di grande utilità per la verifica dei metodi previsionali che si intende sviluppare.

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

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Non previste, ma da non escludere, in funzione dello sviluppo della ricerca.

Napoli, 12 febbraio 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**.