



**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*)

E il sottoscritto prof. Gian Piero Lignola

(PO ☐ PA X RU ☐ RTD ☐) afferente al Dipartimento di Strutture per
l'Ingegneria e l'Architettura

S.S.D. (*indicare codice e nome per esteso ICAR 09 - Tecnica delle Costruzioni*)

CHIEDONO

di essere inseriti 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.



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

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) (Norwegian 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).

Gian Piero Lignola

Gian Piero Lignola received First-class Degree (with honours) in Civil Engineering, University of Naples Federico II, Naples (Italy), in 2002, discussing the thesis "Comportamento Sperimentale di Pannelli in Muratura di Tufo Rinforzati con Materiali Compositi", (Tutors: Prof. Edoardo Cosenza and Prof. Gaetano Manfredi). He received his Ph.D. in in Seismic Risk (19th cycle) at University of Naples Federico II in 2006, discussing the thesis "RC hollow members confined with FRP: Experimental behavior and numerical modelling", (Tutor: Prof. Gaetano Manfredi). Since 1st November 2007 he has been Assistant Professor of Structural Engineering at University of Naples Federico II and confirmed in the role in 2010. In December 2013 he obtained the national scientific qualification to function as Associate Professor. In July 2017 he obtained the national scientific qualification to function as Full Professor.

Since 30th December 2016 he is Associate Professor of Structural Engineering at University of Naples Federico II.

Since 2014 he is member of the Scientific Council of the interdepartmental center "Magna Grecia Studies" University of Naples.

In 2013 he was member of the Board of Teachers of the Doctoral Course "History and conservation of architectural heritage and landscape" University of Naples.

Gian Piero Lignola carries out his theoretical, numerical and experimental research activities mainly in the following fields: analysis of historical/monumental and archaeological structures, non linear



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

behaviour of masonry and reinforced concrete (rc) structures, seismic strengthening of masonry and rc members using advanced materials, Finite Elements Analysis of masonry and rc structures, seismic behaviour of masonry structures, analysis of hollow bridge piers, strengthening design using composites, analysis of shallow cavities and jet grouted tunnels, modelling of corrosion effects in reinforcement and concrete degradation, use of Digital Image Correlation, telepresence and distributed database for European research infrastructures.

He is author of more than 250 papers, published on international journals, or presented to both national and international conferences and commissions.

He is Associate Member of American Society of Civil Engineers (ASCE); member of International Masonry Society (MSC); member of International Institute for FRP in Construction (IIFC); member of WG 9.3 "FRP Reinforcement" of fib (Federation Internationale du Beton); staff member of RILEM Technical Committees TC 223-MSC "Masonry strengthening with composite materials" (now TC 250-CSM "Composites for sustainable strengthening of masonry") and TC 234-DUC "Design procedures for the use of composites in strengthening of reinforced concrete structures". He is member of American Concrete Institute (ACI) Italy Chapter.

He joined the drafting panel of CNR-DT 215 Document– Guide for the Design and Construction of Externally Bonded Fibre Reinforced Inorganic Matrix Systems for Strengthening Existing Structures issued by Italian National Research Council, Rome, Italy.

He is Principal Investigator of a 0.5 million euros PRIN 2017 project "DETECT-AGING - Degradation Effects on sTructural saffEty of Cultural heriTAGE constructions through simulation and health monitorING", funded by the Italian Ministry MIUR.

In 2018 he got Regino Gayoso Blanco Prize, at "Building Pathology and Constructions Repair (CINPAR2018)" conference for best technical article

In 2015 he got Mirko Ros Silver Medal Award by EMPA (3rd Conference on Smart Monitoring, Assessment and Rehabilitation of Civil Structures SMAR 2015 Antalya - Turkey) for the best paper on Rehabilitation of Civil Structures

In 2013 he got Recognition for the best works of the 2nd Conference on Smart Monitoring, Assessment and Rehabilitation of Civil Structures (SMAR 2013 Istanbul - Turkey)

In 2012 he got Recognition for the best works of the 8th International Conference on Structural Analysis of Historical Constructions (SAHC 2012 Wroclaw - Poland)

In 2017 he was Delegate for the "Cultural Heritage" thematic area of the Idis Foundation - Città della Scienza in Futuro Remoto 2017

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

n. 7	Alessandro Flora <i>specificare tipologia di borsa: ateneo, pon, por, senza borsa, ecc.</i> - 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
------	--



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

	(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).
n. 2	Gian Piero Lignola <i>specificare tipologia di borsa: ateneo, pon, por, senza borsa, ecc.</i> • Stefano Belliazzi, borsa di Ateneo (dottorato in Ingegneria dei prodotti e dei processi industriali, co-tutore A. Prota). • Felice Saviano, borsa finanziata dal PRIN 2017 (dottorato in Ingegneria Strutturale, Geotecnica e Rischio Sismico).

3. Titolo della ricerca proposta

Static and dynamic critical aspects in the preservation of monuments and historic sites

4. Area tematica

Ingegneria Geotecnica **X**

Ingegneria Strutturale **X**

Rischio Sismico ☐

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

The preservation of the historic heritage is one of the main challenges civil engineering has to face worldwide and in Italy in particular. Sites and structures of historic or artistic value are traces of the past that are more and more important to identify local differences in history and tradition, now that globalization is tending to smoothen differences around the world. Italy is certainly a country where



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

such a need is strongly felt, having the highest concentration of sites and buildings of interest for UNESCO. Dealing with valuable sites and buildings poses a number of peculiar problems, and it has been recognised for a long time that their preservation is an interdisciplinary activity. The general principles of restoration and maintenance, and the constraints to interventions, have been stated in time from the Athens Charter (1933) first and Venice Charter (1964) subsequently. Among the different disciplines involved in preservation, geotechnical and structural engineering play a key role as long as the existence itself of the monument is concerned. The research that is proposed herein as a Ph.D. topic will be developed considering the close connection among geotechnical and structural problems of monuments and historic sites, both under static and dynamic conditions. The work will start from a general classification of the peculiar problems posed by old masonry structures, classifying different foundation systems, kinds of masonry structures, and typical shapes. The research will analyse the available literature information on static problems of monuments, in relation to their peculiar characteristics and to soil conditions, trying to sort out the effects of static and dynamic actions. In the second part of the activity, one or more valuable existing structures in seismic areas will be considered as paradigmatic examples of a correct preservation procedure. A detail characterization of soil profile and characteristics, seismic actions and structural properties will be carried out. Soil-structure interaction will be considered in the static and dynamic analysis, in order to assess quantitatively what are the critical information missing in simplified analyses where such an interaction is overlooked. Once a clear understanding of the behaviour of the structure, and its response to design earthquakes, will be available, possible alternative solutions to retrofit or isolate the structure will be analysed. This will be done with the declared goal to respect in the widest possible way the prescriptions of the Venice charter, that state the need to try and preserve integrity (in its widest meaning) as much as possible. Therefore, innovative solutions will be considered, possibly introducing Geotechnical Seismic Isolation (GSI) systems to tackle the seismic risk without touching (or touching at the least) the structure. Innovative structural retrofitting and strengthening solutions will be considered as well. Centrifuge tests will be carried out in Cambridge, to test experimentally the effectiveness of the solutions proposed. Finally, the experimental results will be analysed, in cooperation with the researchers of the University of Minho, through FEM modelling. Such a modelling will be carried out not only averaging the masonry characteristics but introducing details of the true geometrical configuration of the masonry, considering the non linear behaviour of the different parts and of the innovative retrofitting systems.

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

1. Di Ludovico M., A. Chiaradonna, E. Bilotta, A. Flora, A. Prota (2020). Empirical damage and liquefaction fragility curves from 2012 Emilia earthquake data. Earthquake Spectra
DOI:10.1177/8755293019891713.
2. Nappa V. - Bilotta E. - Flora A. 2019. Experimental and numerical investigation on the effectiveness of polymeric barriers to mitigate vibrations. Geotechnical and Geological Engineering, <https://doi.org/10.1007/s10706-019-00932-y>
3. Flora A., D. Lombardi, V. Nappa, E. Bilotta (2018). Numerical analyses of the effectiveness of



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

- soft barriers into the soil for the mitigation of seismic risk. *Journal of Earthquake Engineering*, 22(1), pp. 63-93. <http://dx.doi.org/10.1080/13632469.2016.1217802>.
4. Flora A., Lancellotta R., Viggiani C. (2018). A first insight into towers' behaviour: geotechnical and structural mechanisms, leaning instability, long-term behaviour. In *Geotechnics and Heritage: Historic Towers*. CRC press, Taylor & Francis Group, Lancellotta R., Flora A., Viggiani C. Eds, London: pp. 5-13.
 5. Nappa V., E. Bilotta, A. Flora, L. Amato (2017). Field trials on soft grouting barriers to mitigate vibrations effects. 3rd International Conference on Performance-based Design in Earthquake Geotechnical Engineering (PBD-III) in Vancouver, BC, Canada, July 16-19, 2017, Paper 179, 1-6.
 6. Nappa V., Bilotta E., Flora A., Madabhushi G. (2016). Centrifuge modelling of the seismic performance of soft buried barriers. *Bulletin of Earthquake Engineering*, 14(10), pp. 2881-2901, DOI 10.1007/s10518-016-9912-9.
 7. Lombardi, D., Bilotta, E., Flora, A. (2015). Soft grouting for the mitigation of seismic risk. *Geotechnical Engineering for Infrastructure and Development – Proc. of the XVI European Conference on Soil Mechanics and Geotechnical Engineering, ECSMGE 2015*, Edimburgo, UK, 4, pp. 2159-2164.
 8. Flora A. (2013). Monuments, historic sites, case histories. General Report, Technical Committee 301, Proc of the 18th International Conference on Soil Mechanics and Geotechnical Engineering, Parigi (Francia): 3087-3094, Delage P., Desrues J., Frank R., Puech A., Schlosser F. Ed., Presses des Ponts. ISBN 978-2-85978-477-5.
 9. Lombardi D., Flora A., Lirer S., Silvestri F. (2013). An innovative approach for reducing the seismic risk of existing buildings and historic sites. Proc. of the International Symposium on the Preservation of Monuments and Historic Sites – TC301, Napoli, maggio 2013, Bilotta E., Flora A., Lirer S., Viggiani C. Eds., Taylor & Francis: 507-514 p. ISBN 978-1-138-00055-1.
 10. Lombardi D., Flora A., Lirer S. (2012). A new approach for reducing seismic hazard on existing buildings by unusual deep soil grouting. *International Conference on Ground Improvement and Ground Control (ICGI 2012)*, 30 Oct. – 2 Nov, University of Wollongong, Australia, B. Indraratna, C. Rujikiatkamjorn and J S Vinod Editors, ISBN: 978-981-07-3577-7
 11. Lignola Gian Piero, Di Sarno Luigi, Di Ludovico Marco, Prota Andrea (2016). The protection of artistic assets through the base: isolation of historical buildings: a novel uplifting technology. *MATERIALS AND STRUCTURES*, vol. 49, p. 4247-4263, ISSN: 1359-5997, doi: 10.1617/s11527-015-0785-1
 12. Ramaglia G., Lignola G.P., Prota A. (2016). Collapse analysis of slender masonry barrel vaults. *ENGINEERING STRUCTURES*, vol. 117, p. 86-100, ISSN: 0141-0296, doi: 10.1016/j.engstruct.2016.03.016
 13. Gian Piero Lignola, Vincenzo Giamundo, Gianluigi de Martino (2015). Influence of short segments in the trabeation with opposing inclined edges on the seismic vulnerability of the marble blocks colonnade in the archaeological site of Pompeii. *INTERNATIONAL JOURNAL OF ARCHITECTURAL HERITAGE*, vol. 9, p. 883-895, ISSN: 1558-3058, doi: 10.1080/15583058.2014.883447
 14. V. Giamundo, V. Sarhosis, G.P. Lignola, Y. Sheng, G. Manfredi (2014). Evaluation of different computational modelling strategies for the analysis of low strength masonry structures. *ENGINEERING STRUCTURES*, vol. 73, p. 160-169, ISSN: 0141-0296, doi: 10.1016/j.engstruct.2014.05.007



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

15. Manfredi G., Lignola G.P., Voto S. (2013). Military quarters 'Caserma Principe Amedeo' in Nola, Italy: damage assessment and reconstruction of a partially collapsed XVIII century complex. *INTERNATIONAL JOURNAL OF ARCHITECTURAL HERITAGE*, vol. 7, p. 225-246, ISSN: 1558-3058, doi: 10.1080/15583058.2011.629020
16. Lignola G. P., Manfredi G. (2011). Damage assessment and design of structural interventions for Monte di Pietà in Naples, Italy. *INTERNATIONAL JOURNAL OF ARCHITECTURAL HERITAGE*, vol. 5, p. 647-676, ISSN: 1558-3058, doi: 10.1080/15583058.2010.483565
17. G.P. Lignola, E. Nigro, E. Cosenza (2010). Seismic vulnerability of natural stone pinnacles on the Amalfi Coast in Italy. *JOURNAL OF CULTURAL HERITAGE*, vol. 11, p. 68-80, ISSN: 1296-2074, doi: 10.1016/j.culher.2009.04.002
18. Lignola G. P., Manfredi G. (2010). A combination of NDT methods for the restoration of monumental façades: the case study of Monte di Pietà (Naples, Italy). *JOURNAL OF CULTURAL HERITAGE*, vol. 11, p. 360-364, ISSN: 1296-2074, doi: 10.1016/j.culher.2009.11.010
19. ROMANO, NUNZIO, LIGNOLA, GIAN PIERO, BRIGANTE, MICHELE, BOSSO, LUCIANO, CHIRICO, GIOVANNI BATTISTA (2016). Residual life and degradation assessment of wood elements used in soil bioengineering structures for slope protection. *ECOLOGICAL ENGINEERING*, vol. 90, p. 498-509, ISSN: 0925-8574, doi: 10.1016/j.ecoleng.2016.01.085
20. V. Giamundo, G.P. Lignola, A. Prota, G. Manfredi (2014). Nonlinear analyses of adobe masonry walls reinforced with fiberglass mesh. *POLYMERS*, vol. 6, p. 464-478, ISSN: 2073-4360, doi: 10.3390/polym6020464

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

PRIN 2017 DETECT-AGING - Degradation Effects on sTructural safEty of Cultural heriTAGE constructions through simulation and health monitorING

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)

Per il carattere interdisciplinare della tesi, si prevede di fare svolgere al dottorando un



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

periodo di 9 mesi all'estero, diviso in due sottoperiodi così organizzati:

- *Primo periodo (6 mesi)*: questo periodo sarà trascorso presso lo Schofield Centre dell'Università di Cambridge (UK) durante il secondo anno di dottorato. Questo prestigioso centro di ricerca è dotato di una centrifuga geotecnica, che consente di applicare al modello in scala ridotta un campo gravitazionale amplificato. In tal modo è possibile riprodurre correttamente il comportamento meccanico del terreno, e quindi anche tutti i meccanismi di interazione terreno-struttura direttamente dipendenti dallo stato tensionale corrente, ai livelli tensio-deformativi realmente agenti nel caso di interesse. Durante il soggiorno, lo studente eseguirà alcune prove in centrifuga per simulare l'efficacia di possibili tecniche di mitigazione del rischio sismico che non prevedano interventi strutturali (isoalimento geotecnico sismico), e che quindi siano rispettose al massimo livello dell'integrità dell'opera da proteggere. Referente inglese delle attività sarà la prof. Giulia Viggiani (gv278@cam.ac.uk)
- *Secondo periodo (3 mesi)*: in questo secondo periodo, lo studente svolgerà attività di ricerca presso l'Università di Minho (Portogallo), dove è presente un importante gruppo di ricerca sul comportamento statico e dinamico di strutture storiche in muratura, coordinato dal prof. Paulo Lourenço (pbl@civil.uminho.pt). Alcuni dei modelli più avanzati per la simulazione delle murature in codici agli elementi finiti come il DIANA FEA per analisi di dettaglio di problemi strutturali non lineari statici e dinamici sono stati sviluppati dal Prof. Lourenço. Durante la permanenza lo studente potrà approfondire le basi teoriche e applicative di tali modelli mediante il software DIANA FEA che avrà già adoperato per simulare i casi di studio presso l'Università di Napoli, esplorando anche le diverse opportunità di modellazioni 3D solide o a shell.

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

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**.