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

XXXVIII CICLO

Il sottoscritto prof. Gian Piero Lignola

(PO **X** PA □ RU □ RTD □) afferente al Dipartimento di Strutture per l'Ingegneria e l'Architettura S.S.D. ICAR/09 Tecnica delle Costruzioni

CHIEDE

di essere inserito nell'elenco dei tutor per il XXXVIII ciclo.

1. Curriculum del proponente (max 500 parole)

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. Since 30th December 2016 he has been Associate Professor of Structural Engineering at University of Naples Federico II. In July 2017 he obtained the national scientific qualification to function as Full Professor.
Since 18th July 2022 he is Full 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 behaviour of masonry and reinforced concrete (rc) structures, seismic strengthening of masonry and rc members using advanced materials, Finite Elements Analysis of masonry and re 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 300 papers, published on international journals, or presented to both national and international conferences and commissions.
He is Associate Editor of ASCE journal of Composites for Constructions, 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 satEty 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. 4	*Stefano Belliazzi (XXXII ciclo, graduated in 2020, ateneo)* *Armando Benenato (XXXIV ciclo, graduated in 2022, Niccolò Cusano)*

	Giovanni Crisci (XXXIV ciclo, Napoli Parthenope) *Felice Saviano (XXXV ciclo, PRIN)*

3. Titolo della ricerca proposta
Seismic modelling and assessment of historical constructions, monuments and sites

4. Area Tematica
Ingegneria Geotecnica □ Ingegneria Strutturale **X** Rischio Sismico □

5. Sintesi del progetto di ricerca (max 500 parole. Stato dell'arte, breve programma previsto per le attività e obiettivi)
Natural and man-made events induce serious threats to cultural heritage constructions, most of them consisting of masonry structures such as buildings, churches, bell towers and arch bridges. In the case of natural events, the World Bank has reported that the number of disasters and affected people worldwide has been rapidly raising. The rise in population and urbanization has produced a dramatic increase in the exposure, resulting in catastrophic consequences even after relatively minor events. Italy, which has the highest number of UNESCO World Heritage Sites, has suffered a huge toll in terms of earthquake damage to the cultural heritage. In this context, wrong retrofit interventions have been found to be an additional source of structural vulnerability. Masonry constructions also show poor structural performance and suffer heavy damages under man-made actions, such as example, ground settlements. The main purpose of the proposal is to assess the effects of aging, material degradation, intrinsic vulnerability, on structural safety of cultural heritage, with particular reference to masonry structures. Through the combined use of structural models and experimental

outcomes, indications will be provided for the identification and quantification of structural damage, for the management of built cultural heritage.

Advanced numerical simulations will support the correlations from the scale of material up to that of structures. Experimental activities follow the same multiscale approach: from small-scale specimens, to real construction prototypes. Field validations on real historical structures (in Archaeological sites, too) will be the final target.

Effects of degradation of materials, previous consolidation interventions (e.g. corrosion of metal tying bars or meshes inserted in reinforced plasters) will be evaluated. A multiscale approach will be considered by assessing the impact from the scale of material up to that of whole structure. Although complexity of cultural heritage assets often leads to the adoption of 3D Finite Element Models (FEM), also simplified evaluations will be performed. Monumental masonry structures are usually characterized by huge dimensions and complex and irregular geometries that make the numerical modelling a challenging task. Although recent generation procedures facilitate their implementation, the required computational effort is often not feasible at the level of engineering practice and for real time damage identification. At the current stage of development, validation has been essentially limited to the seismic engineering field and mostly oriented to ordinary residential buildings, neglecting the features that often characterize historical buildings. A focus will be also done on the contents of museums and artifacts for their vulnerability and conservation.

6. Pubblicazioni sul tema di ricerca

A. Sandoli, B. Calderoni, G.P. Lignola and A. Prota "Seismic vulnerability assessment of minor Italian urban centres: development of urban fragility curves". Bull of Earth Engineering. https://doi.org/10.1007/s10518-022-01385-0

S. Belliazzi, G.P. Lignola and A. Prota "Simplified approach to assess the vulnerability of masonry buildings under tsunami loads". Proceedings of the Institution of Civil Engineers – Structures and Buildings. https://doi.org/10.1680/jstbu.20.00147

S. Belliazzi, G.P. Lignola and E. Cosenza "Dynamic response of asymmetric bodies assuming a rocking behavior". Proceedings of the Institution of Civil Engineers – Structures and Buildings. Pages 1-11. https://doi.org/10.1680/jstbu.20.00151

A. Flora, A. Chiaradonna, L. De Sanctis, G.P. Lignola, V. Nappa, S. Oztoprak, G. Ramaglia and S. Sargin "Understanding the Damages Caused by the 1999 Kocaeli

Earthquake on One of the Towers of the Theodosian Walls of Constantinople". In International Journal of Architectural Heritage, https://doi.org/10.1080/15583058.2020.1864512

G. Ramaglia, G.P. Lignola and E. Cosenza "Unified Approach for Structural Analysis of Curved Elements under Vertical Loads and Various Settlements". International Journal of Architectural Heritage, 2022 16(2):208-241. https://doi.org/10.1080/15583058.2020.1766160

T. Celano, F. Ceroni and G.P. Lignola "Behaviour of masonry walls strengthened with fibre-reinforced cementitious materials". Engineering and Computational Mechanics, Volume 174 Issue 4, December, 2021, pp. 193-214. https://doi.org/10.1680/jencm.21.00009

G. Ramaglia, G.P. Lignola, F. Fabbrocino and A. Prota "Structural analysis of historical masonry churches: the case study of S. Giuseppe delle Scalze (Naples, Italy)". Special Issue "Simple Mechanical Models for Unreinforced Historic Masonry Constructions", on the International Journal of Masonry Research and Innovation. Volume 6, Issue 4, Pages 472 – 501. 2021. https://doi.org/10.1504/IJMRI.2021.10037509

G.P. Lignola, L. Di Sarno, M. Di Ludovico and A. Prota "The protection of artistic assets through the base: isolation of historical buildings: a novel uplifting technology". SPRINGER Materials and Structures, Volume 49, Issue 10. October 2016:4247–4263. https://doi.org/10.1617/s11527-015-0785-1

G.P. Lignola, V. Giamundo and G. de Martino "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, Volume 9 No. 7, October 2015:883-895. https://doi.org/10.1080/15583058.2014.883447

G.P. Lignola and G. Manfredi "Damage assessment and design of structural interventions for Monte di Pietà in Naples, Italy". International Journal of Architectural Heritage 5:6, 2011:647-676. https://doi.org/10.1080/15583058.2010.483565

G.P. Lignola, E. Nigro and E. Cosenza "Seismic Vulnerability of natural stone pinnacles on the Amalfi Coast in Italy". Journal of Cultural Heritage Vol. 11, Issue 1, January-March 2010: 68-80 https://doi.org/10.1016/j.culher.2009.04.002

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

The research activity is supported by a number of ongoing research projects, 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

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)
In this period, the student will carry out research activities at the University of Minho (Portugal), where there is an important research group on the static and dynamic behaviour of historical masonry structures, coordinated by prof. Paulo Lourenço (pbl@civil.uminho.pt). Some of the most advanced models for the simulation of masonry in finite element codes such as the DIANA FEA for detailed analysis of static and dynamic non-linear structural problems have been developed by Prof. Lourenço. During the stay the student will be able to deepen the theoretical and applicative bases of these models using the DIANA FEA software that he/she will have already used to simulate the case studies at the University of Naples, also exploring the different opportunities of, solid or shell, 3D modelling.

10. Eventuali collaborazioni con imprese/aziende sul tema di ricerca (max 300 parole)
Non previste, ma da non escludere (e.g. Parco Archeologico di Pompei), in funzione dello sviluppo della ricerca

Napoli, 19 Luglio 2022

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 **mercolerdì 20/07/2022**