

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

XXXIX CICLO

Il sottoscritto prof. Costantino Menna

(PO \square PA X RU \square RTD \square) 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 XXXIX ciclo.

1. Curriculum del proponente (max 500 parole)

<u>Costantino Menna</u> is currently Associate Professor of Structural Engineering at the Department of Structures for Engineering and Architecture of the University of Naples Federico II. He graduated in Materials Engineering in 2009 and received his Ph.D. in Materials Engineering and Structures in 2013 at the same university, working on damage modeling of advanced composite materials. In April 2018 he obtained the National Scientific Qualification as Associate Professor (ICAR-09).

He is involved in several multidisciplinary research activities mainly focused on advanced materials and technologies for civil and industrial applications, including: experimental assessment and theoretical modeling of innovative materials used for structural retrofit of existing structures, finite element modeling, sustainability assessment procedures, and additive manufacturing in the construction industry. He was visiting research scholar in several foreign institutions: École Polytechnique de Montréal (Canada), Department of Engineering Science and Mechanics of Penn State University (USA), Laboratoire de Mécanique des Solides of Ecole Polytechnique (Paris), University of Greenwich (UK). He is chair of Task Group 2.11: "Structures made by digital fabrication" of fib and

member of RILEM Technical Committee 276-DFC. In 2019 was selected as "User-Committee" member for the grant funded by the Dutch National Science Foundation entitled: "Systematic development of printable SHCCs" (2019-2021). He is external expert for the European Commission for the Horizon 2020 entitled: "Integrated techniques for the seismic strengthening and energy efficiency of existing buildings".

He is currently PI of the project entitled: Digi-Beton: digital fabrication of construction systems made of AAC. He PI of the research project entitled: INTERACTS: INtegraTEd and Reliable ApproaChes for susTainability assessment of existing buildingS, funded by PROGRAMMA STAR Linea.



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He is holder of 5 national and 1 international patents, co-founder of the Spinoff FED, Future Environmental Design, and of the Spinoff ETESIAS s.r.l.

He is author of more than 50 scientific papers published in international peer-reviewed journals or presented at international conferences, and 6 book chapters.

<u>Marco Gaetani d'Aragona</u> is currently Research Fellow - RTD-A - of Structural Engineering at the Department of Structures for Engineering and Architecture of the University of Naples Federico II. He graduated in Structural and Geotechnical Engineering in 2011 and received his Ph.D. in Materials Engineering and Structures in 2015 at the same university, working on post-earthquake assessment of non-ductile buildings.

He is involved in several multidisciplinary research activities mainly focused on the seismic assessment of reinforced concrete buildings, including: finite element modeling, simplified mechanical modeling, vulnerability assessment and definition of large scale frameworks for the assessment of seismic performances of existing and retrofitted building typologies, seismic loss assessment and optimal retrofit strategies. He was visiting research scholar at the University of British Columbia (Canada).

He is active member of research projects dealing with computational mechanics and dynamics, inventory of existing building typologies, seismic risk assessment of as-built and retrofitted infilled RC buildings, vulnerability assessment of reinforced concrete buildings.

He is author of more than 30 scientific papers published in international peer-reviewed journals or presented at international conferences, and 2 book chapters.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio							
n. 1	Ph.D. scholarship funded within the programme: PON FSE-FESR Ricerca e Innovazione 2014- 2020. Azione I.1 – Dottorati innovativi a caratterizzazione industriale						
	Ph.D. candidate: Laura Esposito - Structural, Geotechnical Engineering and Seismic Risk - XXXIV cycle						

3. Titolo della ricerca proposta

Integrated assessment of seismic-energetic performances towards sustainable retrofitting



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of existing Italian buildings

4. Area Tematica

Ingegneria Geotecnica 🛛

Ingegneria Strutturale x

Rischio Sismico 🗆

5. Tipologia di borsa per la quale si propone il progetto

Ateneo □

DM 117 (Investimento 3.3) (in questo caso indicare l'azienda co-finanziatrice)

DM 118 (Investimento 4.1 P.A.) □

DM 118 (Investimento 4.1 generici) X DM 118 (Investimento 4.1 Patrimonio culturale) □

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

State of the Art

The vast majority of the Italian building stock was designed and constructed with no reference or according to obsolete energy performance guidelines and seismic design codes. By also considering the ageing and degradation process of building materials, the energy performance and seismic capacity of older buildings may often results inadequate resulting in significant CO2 emission and energy consumption, and representing a significant threat to human lives.



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As a key action of the European Green Deal, an increase in building renovation rate is expected to ensure that ambitious EU targets can be reached by 2030. To speed up this process, forms of incentives and financial support have been enacted for supporting energy retrofit and structural refurbishments of buildings.

Since the building demolition and rebuilt results neither economically feasible and environmentally sustainable at the large scale, the existing Italian building stock requires a comprehensive strategy of renovation to improve its energy performance and reduce seismic vulnerability. However, in the matter of seismic strenghtening of building and other aspectf of building global sustainability are usually considered separately. The current need of improving the performance of existing building to structural and energetic standards are pushing many researchers to evaluated a methodology for integrated approaches. Although some reasearchers addressed technical solution for integrated interventions at the single-building level, there is a lack of large-scale frameworks to plan the prioritization of interventions in both the fields of energetic and seismic performance, according to economic resources. In fact, a combined approach could be useful for evaluating the possible interaction when an intervention campaign must be planned giving priority to some areas rather than others

Objectives

The main goal of this PhD project is to develop practical tools and a comprehensive framework supporting the decision-making process at the large scale towards a synergic action inspired to a general improvement of building livability, management and safe via combined energy refurbishment and seismic retrofitting.

Program

The PhD research activities will be focused on the structural and energy assessment and integrated retrofit strategies for existing infilled reinforced concrete (RC) buildings. In particular, the following program is proposed:

- 1st year: Study the state-of-the-art of methodologies for the assessment of seismic and energy performances of existing infilled RC buildings; development and understanding of the main issues for the structural and energy assessment of RC buildings; identification of a case-study building to perform first assessment.
- 2nd year: Building of a structural model for the case-study building to be analyzed via a nonlinear finite element analysis software; simulations of energy



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- performances with dedicated energy analysis software; understanding of principle of sustainable construction of buildings and life-cycle assessment, study of possible seismic and energy retrofitting techniques and integrated retrofit strategies; definition of the optimal integrated retrofit strategy in the perspective of long-term sustainability of a building.
- **3**rd year: Definition of a framework and simplified analysis tools to assess the integrated seismic and energy performances of existing buildings and select the optimal integrated retrofit strategy for large scale purposes.

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

- 1. Menna, C., Felicioni, L., Negro, P., Lupíšek, A., Romano, E., Prota, A., & Hájek, P. (2022). Review of methods for the combined assessment of seismic resilience and energy efficiency towards sustainable retrofitting of existing European buildings. Sustainable Cities and Society, 77, 103556.
- 2. Menna, C., Del Vecchio, C., Di Ludovico, M., Mauro, G. M., Ascione, F., & Prota, A. (2021). Conceptual design of integrated seismic and energy retrofit interventions. Journal of Building Engineering, 38, Article 102190.
- 3. **Menna, C.**, Vitiello, U., Mauro, G. M., Asprone, D., Bianco, N., & Prota, A. (2019). Integration of seismic risk into energy retrofit optimization procedures: A possible approach based on life cycle evaluation. IOP Conference Series: Earth and Environmental Science, 290(1), Article 012022.
- 4. Gaetani d'Aragona, M., Polese, M., Prota, A., (2022). Stick model for as-built and retrofitted infilled RC frames. Engineering Structrures. *In press.*
- 5. Gaetani d'Aragona, M., Polese, M., Prota, A. (2020). Stick-It: A Simplified Model for Rapid Estimation of IDR and PFA for Existing Low-Rise Symmetric Infilled RC Building Typologies. Engineering Structures, 223, 111182.
- Gaetani d'Aragona, M., Polese, M., Di Ludovico, M., Prota, A., (2018). Seismic vulnerability for RC infilled frames: Simplified evaluation for as-built and retrofitted building typologies. Buildings, 8(10): 137.
- 7. Polese M., Gaetani d'Aragona, M., Di Ludovico, M., Prota, A., (2018). Sustainable selective mitigation interventions towards effective earthquake risk reduction at the community scale. Sustainability, 10, 2894.



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8.	Eventuali	progetti o	di ricerca	finanziati in	cui l'attività	si inserisce
		-				

- DPC-ReLUIS joint programme 2022-2024 WP5: Task 5.1 Interventi integrati e sostenibili per la riqualificazione di edifici esistenti.
- DPC-ReLUIS joint programme 2022-2024 WP5: Task 5.2 Metodi di valutazione integrati.
- International Academic networks

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

- DPC-ReLUIS joint programme 2022-2024 WP5: Task 5.1 Interventi integrati e sostenibili per la riqualificazione di edifici esistenti.
- DPC-ReLUIS joint programme 2022-2024 WP5: Task 5.2 Metodi di valutazione integrati.
- International Academic networks

10. 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)

To be confirmed among the following:

University of Praga: Dr. Petr Hájek (petr.hajek@fsv.cvut.cz), Professor of Civil Engineering at Czech Technical University in Prague, Faculty of Civil Engineering. He is Vice Dean for Research and Head of Department of Architectural Engineering; Head of Division Architecture and Environment at University Centre for Energy Efficient Buildings (UCEEB). His research interests focus on sustainable construction of buildings, complex assessment and rating of building performance quality, LCA, optimization of concrete structures and use of recycled materials. The PhD student will spend his period at University of Praga (6 months in the second year) to understand concepts of sustainable construction of buildings, sustainable urban development, and



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life-cycle assessment. The goal is to address the advantages related to the implementation of integrated seismic and energy retrofitting techniques in terms of reduction of CO2 emission, energy consumption, and waste generation.

Joint Research Centre: The JRC in Ispra is a Directorate-General of the European Commission Energy Efficiency and Climate Change.

The PhD student will spend his period (6 months in the second year) at the Institute for Environment and Sustainability (IES) used to be a specialised institute of the Joint Research Centre (JRC) directorate of the European Commission, based in Ispra, Italy. The IES mission is to provide scientific and technical support to EU policies for the protection of the environment contributing to sustainable development in Europe. The goal is the understanding of state-of the art of integrated seismic and energy retrofitting techniques in terms of reduction of CO2 emission, energy consumption, and waste generation.

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

The research activity might stimulate the cooperation with several engineering and construction companies working on sustainability goals, such as **R.I.N.A. consulting**.

Napoli, 30/06/2023

FIRMA

Costantino Menna Mune Cha

Marco Gaetani d'Aragona

Men Gertan d'Augure

Il presente modulo va compilato in ogni sua parte ed inviato all'indirizzo di posta elettronica <u>phd.dist@unina.it</u> entro e non oltre **il 30/06/2023.**