



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. \_\_\_\_\_Andrea Prota\_\_\_\_\_

(PO ☐ PA ☐ RU ☐ RTD ☐) afferente al Dipartimento di \_\_\_\_\_

\_\_\_\_\_Strutture per l'Ingegneria e l'Architettura (DiSt)\_\_\_\_\_S.S.D. (*indicare codice e nome per esteso* \_\_\_\_\_ICAR/09 Tecnica delle Costruzioni\_\_\_\_\_)

CHIEDE

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

**1. Curriculum sintetico del proponente (max 500 parole)**

Andrea Prota, Full Professor at UNINA, Head of the department of Structures for Engineering and Architecture, received his PhD in Civil Engineering in the 1998 at the University of Napoli Federico II. His research activities consists in the theoretical and experimental research in the following fields: non-linear behavior of reinforced concrete and masonry structures, seismic retrofit of concrete and masonry structures with composites, behavior of concrete structures reinforced with composite bars, reinforcement bars behavior under monotonic and cyclic compression actions, polymeric and composite structures, protection of structures subjected to fast dynamic loads, strategies and techniques to reduce seismic risk of built environment.. He is currently member of: ACI 440, head of the subcommittee 400M; fib TG 5.1; RILEM TC on Composite Materials, ISO/TC 71 /SC 6, CNR DT 200, DT 203, fib bulletin 14,40, 90, ACI 440. ASTM D7331. Coordinator of the WP 2 Reinforced Concrete Structures within the DPC-ReLUIS project 2014-2016, 2016-2018. He was involved in many research projects founded by national or international agencies or private companies. In particular: coordinator of the DPC-ReLUIS PI 2019-2021 WP5: Fast and Integrated retrofit solutions, scientific coordinator of the research project METRICS (Methodologies and Technologies for the management and Regeneration of Historical center and monumental buildings), Project STRIT (Tools and Technologies for the Risk Management of Transportation Infrastructures), Project PROVACI (Technologies for the Seismic safety enhancement of monumental buildings), Project MACE (Innovative Composite Materials for constructions), Project MAMAS (Advanced Structural Materials for application on buildings), Project SAS (Security of Airport Structures), Project ENCORE (RTN Marie-Curie), Project PON MITRAS (Materials, Technologies and Design Methodologies for the Innovative Repair and Retrofit of Transportation Infrastructures), Project PON TEMPES (Innovative Technologies and Materials for the Seismic protection of Historical Buildings). Scientific coordinator of the project for Research and Development of Mapei products: "applicability and validation of the FEM modeling for different thermal insulation of exterior enclosure"; Scientific coordinator of the scientific consultancy for the National Railway Network "Seismic assessment of the RC buildings and anch vault bridges, development and management of the database"; Scientific coordinator of the research and



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development project for Schnell S.p.A. for "Scientific Consultancy for seismic experimental testing of a building made of mock-up Concrewall EVO panels". Reviewer of Technical Papers for the following journals: ASCE Journal of Composites for Construction, ASCE Journal of Structural Engineering, ACI Structural Journal, ACI Material Journal, Bulletin of Earthquake Engineering, Composites Part B, Engineering Structures, Composite Structures, Construction and Building Materials.

He is author of more than 450 publications. Other indicators:

- 177 ISI papers and 354 conference papers, h-index 35/44 and 4377/6682 citations (Scopus/Google scholar)
- Supervisor of 30 concluded PhD and 48 MSc theses
- R&D Projects: 15 as PI and 37 as team member
- Supervisor of 11 concluded Postdoc projects

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

	<i>specificare tipologia di borsa: ateneo, pon, por, senza borsa, ecc.</i>
<i>n. __1__</i>	Mele Annalisa (Phd program in Structural and Geotechnical Engineering and Seismic risk, XXXV cicle, ongoing) grant: Ateneo
<i>n. __2__</i>	Autiero Francesca (PhD program in Industrial Product and Process Engineering, XXXVI cicle) grant: Aeteneo
<i>n. __3__</i>	Di Domenico Mariano (PhD program in Industrial Product and Process Engineering, XXXIII cicle) grant: Ateneo

**3. Titolo della ricerca proposta**

Developing innovative seismic retrofit interventions through large-scale pseudo-dynamic experimental tests

**4. Area tematica**



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Ingegneria Geotecnica ☐

Ingegneria Strutturale ☒

Rischio Sismico ☐

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

The main goals and novelty of the research is the development of integrated retrofit solutions for existing reinforced concrete (RC) buildings that can be implemented in a short period of time, thereby minimizing the level of disruption. Indeed, the real barrier to the implementation of effective structural and energy retrofitting of existing school buildings is the duration of the intervention, which commonly leads to the interruption of the activities for several years. This may significantly influence the opinions of stakeholders, who often opt for limited renovations that mainly focus on aesthetic restyles or minor energy refurbishments, instead of substantial retrofitting. To overcome this issue, the primary scope of this project is to propose solutions and retrofit strategies that can be implemented by acting on the building envelope and operating from the exterior of the structure. To this end, of particular interest in this research are innovative and high-performance materials, i.e. fiber-reinforced composite materials, high-performance concrete, self-healing and self-repairing concrete, shape memory alloy) and promising low-damage retrofit strategies (such as base isolation by uplifting an entire building and a rocking system for structural and non-structural components). Their application in retrofitting should take into account their integration with innovative technologies used to improve energy performance. Real case-study school buildings will be analyzed to identify their main structural weaknesses, typical damage and deterioration and ways to improve energy consumption and living conditions. Existing buildings relying on reinforced concrete (RC) moment-resisting frames with hollow clay-brick infill panels will be considered, as this is one the most common construction standards of the last century. The real core of this research project is the testing and validating of the proposed retrofit solutions on a full-scale prototype, which will be testes at the new full-scale laboratory of the DiSt-UNINA at CeSMA San Giovanni. Experiments on the building prototypes with different strengthening configurations will be conducted to validate the proposed retrofit solutions. In particular, a set of different retrofit options with increasing performances, levels of disruption and cost will be proposed for each of the building prototypes. The first option is to act on the building envelope. The benefits of the different solutions will be assessed in terms of: increased structural safety; a reduction of damage to the building and economic seismic losses; and improved energy performances. This research program consists of three phases: 1) experimental testing by using a pseud-dynamic testing framework. Thus, part of this research program consists in the development of the interface for the control of the tests and for the interaction between the physical prototype representing the laboratory specimen and a numerical model representing the entire building. 2) Developing and testing of innovative retrofit solutions. 3) The results of the experiments will then be used to calibrate refined numerical models that consider both the structural and non-structural performance. This allows to extent the results to large number of case studies.



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

1. De Risi M.T., Del Vecchio C., Ricci P., Di Ludovico M., Verderame G.M., **Prota A.** (2020) Ligth FRP strengthening of reinforced concrete poorly detailed beam-column joints. ASCE Journal of Composites For Construction, (in press), DOI: 10.1061/(ASCE)CC.1943-5614.0001022
2. Del Vecchio C., Di Ludovico M., Balsamo A., **Prota A.**, Cosenza E., (2019), "Experimental response and fiber-reinforced cement composites strengthening of real reinforced concrete columns with poor-quality concrete", Structural Concrete, Journal of the fib, xxx, DOI: <https://doi.org/10.1002/suco.201800278>.
3. Del Vecchio C., Di Ludovico M., Balsamo A., **Prota A.** (2018), "Seismic Retrofit of Real Beam-Column Joints Using Fiber-Reinforced Cement Composites", ASCE Journal of Structural Engineering, 2018, 144(5): 04018026, DOI: 10.1061/(ASCE)ST.1943-541X.0001999.
4. Cosenza E., Del Vecchio C., Di Ludovico M., Dolce M., Moroni C., **Prota A.**, Renzi E. (2018), "The Italian guidelines for seismic risk classification of constructions: technical principles and validation", Bulletin of Earthquake Engineering, Vol. 16, n.12, December 2018, pp. 5905-5935, DOI: 10.1007/s10518-018-0431-8.
5. Di Ludovico, M., **Prota, A.**, Moroni, A., Manfredi, G., Dolce, M. (2016). "Reconstruction process of damaged residential buildings outside historical centres after the L'Aquila earthquake: part II—"heavy damage" reconstruction". Bulletin of Earthquake Engineering, pp. 1- 1-37, ISSN: 1570-761X, doi: 10.1007/s10518-016-9979-3
6. Frascadore, R., Di Ludovico, M., **Prota, A.**, Verderame, G.M., Manfredi, G. Dolce, M., Cosenza, E. (2015). "Local strengthening of RC structures as a strategy for seismic risk mitigation at regional scale". Earthquake Spectra, vol. 31, p. 1083-1102
7. Del Vecchio, C., Di Ludovico, M., Balsamo, A., **Prota, A.**, Manfredi, G., Dolce, M. (2014). "Experimental investigation of exterior RC beam-column joints retrofitted with FRP systems". ASCE Journal of Composites For Construction, Vol. 18, n. 4, DOI: 10.1061/(ASCE)CC.1943-5614.0000459
8. Di Ludovico M., **Prota A.**, Manfredi G. (2010). Structural Upgrade using Basalt Fibers for Concrete Confinement. ASCE Journal of Composites for Construction, Volume 14, n. 5, pp. 541-552
9. Di Ludovico, M., **Prota, A.**, Manfredi, G., and Cosenza, E. (2008). "Seismic Strengthening of an Under-Designed RC Structure with FRP". Earthquake Engineering and Structural Dynamics, vol. 37, pp. 141-162
10. **Prota, A.**, Nanni, A., Manfredi, G. and Cosenza, E. (2004). "Selective Upgrade of Underdesigned Reinforced Concrete Beam-Column Joints Using Carbon Fiber-Reinforced Polymers", ACI Structural Journal, vol. 101, n. 5, pp. 699-707

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



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DPC-ReLUIIS joint programme 2019-2021 WP5: Fast and Integrated retrofit solutions

reSTART-school: Retrofitting Existing School buildings Towards fAst RetrofiT Solutions

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

DPC-ReLUIIS joint programme 2019-2021 WP5: Fast and Integrated retrofit solutions

**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)**

Joint Research Center, JRC, Ispra, Marco Lamperti Tornaghi, Marco.LAMPERTI-TORNAGHI@ec.europa.eu

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

The proposed research activities involves the collaboration with several industrial partners:

- **MAPEI spa**: this partnership aims at the developing of innovative seismic strengthening solutions for the existing RC buildings designed with obsolete code provisions. This company is the worldwide leader in the chemical products for construction industry and in the production and commercialization of innovative building materials. A long scientific collaboration with this department. The planned experimental tests will be used for the validation of the proposed solution. The main scope of the research is to develop international patents to protect the intellectual properties of the proposed solutions.

- **TRIO sistemi e misure srl**: This partnership aims at the further development of the pseudo-



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dynamic testing facilities at the L3 DiSt laboratory located at the CeSMA in San Giovanni a Teduccio, Napoli by including a real time control system. The TRIO srl is a company leader in the development of control systems for the laboratory testing. The proposed research activities aim at integrating an hybrid control systems and the development of a Matlab/Simulink interface with available numerical software (i.e. OpenSees, VecTor2, Ruaumoko).

Napoli, \_\_\_\_\_14/02/2020\_\_\_\_\_

FIRMA

Il presente modulo va compilato in ogni sua parte ed inviato all'indirizzo di posta elettronica [phd.dist@unina.it](mailto:phd.dist@unina.it) entro e non oltre **venerdì 14/02/2020**.