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

XXXVII CICLO

La sottoscritta prof. Claudia CASAPULLA

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

CHIEDE

di essere inserita nell'elenco dei tutor per il XXXVII ciclo.

1. Curriculum del proponente – CV of the proposing tutor

Claudia CASAPULLA (female, MSc. in 1997 and Ph.D. in 2000) is Associate Professor of Structural Engineering at the University of Napoli Federico II, where she is a Staff Member Responsible (SMR) for Laboratories, Courses and Modules of Structural Engineering (Bachelor and Master levels) since 2002.
Her research interests are mainly focused on the seismic vulnerability of masonry structures and innovative modeling of their collapse behavior under static and dynamic loadings, from both numerical and experimental points of view. Recent activities are being devoted to the seismic vulnerability of wall connections in the local mechanisms of masonry buildings and to the analysis and assessment of strengthening interventions with advanced innovative systems (PRIN 2017 SURMOUNT, Coordinated by Prof. Andrea Prota).
At national level, she has been involved as Principal investigator in 1-year Research Program funded by the Campania Region (L.R. n.5/02 year 2003) and as Responsible of a Research Unit in a series of national research projects since 2005, coordinated by ReLUIS and funded by the Italian Civil Protection Department. Among others, she has also been a member of the project "MAED_Physical and virtual Materials Library for Architecture and Design", funded by the University of Napoli Federico II (FARO 2012 - Funding for starting Original Researches).
At international level, in 2018 she was awarded the supervision of a 2-year Marie Skłodowska-Curie Individual Fellowship funded within the EU Horizon 2020 framework (Grant Agreement No. 791235). Her attitude to scientific collaboration at international level is also proved by collaborative works undertaken with research groups of UK universities in Bath, Sheffield, Southampton and Cambridge, from 1998 to 2005. These activities were supported by the Italian CNR (Short-Term Mobility 2000),

MURST (Ph.D. visiting researcher) and UniNa (International Exchange Program 2003), but also through UK funding (EPSRC, Grant GR/R06755/01). Currently, she has active collaborations with the Universities of Sheffield (UK), Minho (PT), UCL (UK) and Budapest (Hungary).
She has served as academic tutor in orientation and training internships for students, in supervising international research fellows and Ph.D. students (including a SAHC Master's thesis at the University of Minho in Portugal), and in training courses for young practitioners (architects and civil engineers), such as the TEMPES Master Course in 2004 supported by Italian MIUR, the specialization courses undertaken in 2016 supported by STRESS s.c. a r.l. (PON03PE_00093_5/F1 METRICS) and the TIASD research Program in 2017 and 2018 supported by German DAAD. She is a peer reviewer for 35 indexed international journals (mostly Elsevier, Springer and Taylor & Francis), associate editor and co-founder of the International Journal of Earthquake and Impact Engineering, editorial board member of 9 international journals and scientific committee member/chair and organizer of sessions of about 20 international conferences. Since 2013, she has been an expert peer reviewer for the Italian scientific evaluation (FIRB, VQR, PRIN, "Rita Levi Montalcini" projects) by REPRISE (Area ERC: PE8). H-index 20/24 and 982/1420 citations (Scopus/Google scholar). She has been featured among the World's Top 2% Scientists 2019, as published by Stanford University on Plos Biology.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio – Ph.D. students of which the proponent has been a tutor in the last three years

no. _1__	*Thomas Celano, XXXIV Cycle of the Ph.D. in "Fenomeni e Rischi Ambientali" (FERIA) – University of Napoli "Parthenope". Ongoing grant: Ateneo*

3. Titolo della ricerca proposta – Research title

Seismic assessment of local out-of-plane mechanisms in masonry buildings and strengthening interventions with advanced innovative systems

4. Area Tematica – Thematic area

Ingegneria Geotecnica □
Ingegneria Strutturale X
Rischio Sismico □

5. Sintesi del progetto di ricerca – Research project synopsis

In masonry buildings without box-like behavior but with good quality masonry, such as most existing unreinforced (URM) masonry buildings in the historic city centers, local out-of-plane failures can take place, even under low intensities of ground motion and especially for peripheral walls. Recurrent vulnerabilities in these buildings are weak connections between orthogonal walls, absence of connecting ties, insufficiently rigid floor diaphragms, low strength and deterioration of materials; the presence of openings and their position in the walls are further relevant aspects.

State of the art

Increasing interest in the analysis of local failures in masonry buildings and strategies for strengthening interventions has lately been registered in the scientific community. Some relevant works, also describing the state of the art, are:

[1] Casapulla, C., Giresini, L., Lourenço, P.B. (2017). Rocking and kinematic approaches for masonry walls as rigid blocks: state of the art and recent developments. *Buildings* 7(3), art. no. 69.

[2] Vlachakis, G., Cervera, M., Barbat, G.B., Saloustros, S. (2019). Out-of-plane seismic response and failure mechanism of masonry structures using finite elements with enhanced strain accuracy. *Engineering Failure Analysis*, 97: 534-555.

[3] Maddaloni, G., Di Ludovico, M., Balsamo, A., Prota, A. (2016). Out-of-plane experimental behaviour of T-shaped full scale masonry wall strengthened with composite connections. *Composites Part B: Engineering*, 93: 328-343.

[4] Ceroni, F., Cu.zzilla, R., Pecce, M. (2016). Assessment of performance of steel and GFRP bars as injected anchors in masonry walls. *Construction and Building Materials*, 123: 78-98.

[5] Novelli, V.I., D'Ayala, D (2019). Use of the knowledge-based system LOG-IDEAH to assess failure modes of masonry buildings, damaged by L'Aquila earthquake in 2009. *Frontiers in Built Environment*, 5:95.

Objective and activities

The objective of the proposed 3-year PhD Program is to analyze the local out-of-plane

mechanisms in masonry buildings and investigate the possibilities of strengthening interventions with advanced innovative systems. The research activities will provide design indications, fundamental for respecting the 'minimum intervention' philosophy for heritage buildings and useful for improving the current relevant Italian standards. The Ph.D. Program will be developed within the PRIN 2017 project entitled "Innovative Systems for the UpgRade of MasOnry structUres and Non sTructural elements (SURMOUNT)", coordinated by Prof. Andrea PROTA of the DiST and involving four Research Units form other Italian universities.

The research activities will cover the following aspects:

- State of the art and recent developments of existing modeling approaches and innovative strengthening techniques for local out-of-plane mechanisms in masonry buildings.
- Evaluation of the ground acceleration corresponding to the activation and the collapse of different kinds of local out-of-plane mechanisms (rocking and flexural failures) by means of classical and advanced approaches existing in the literature (FEM, DEM, Limit Analysis, etc.).
- Analysis of the most recurrent local mechanisms by using and improving an advanced discrete model based on the macro-block modeling approach with frictional resistances and the non linear kinematic approach of limit analysis (see Fig. 1 and the publications of the proponent). This activity includes the construction of pushover curves to compare the capacity in terms of both forces and displacements with the seismic demand though the construction of Acceleration-Displacement Response Spectra (ADRS). The Italian technical codes are used as a reference.

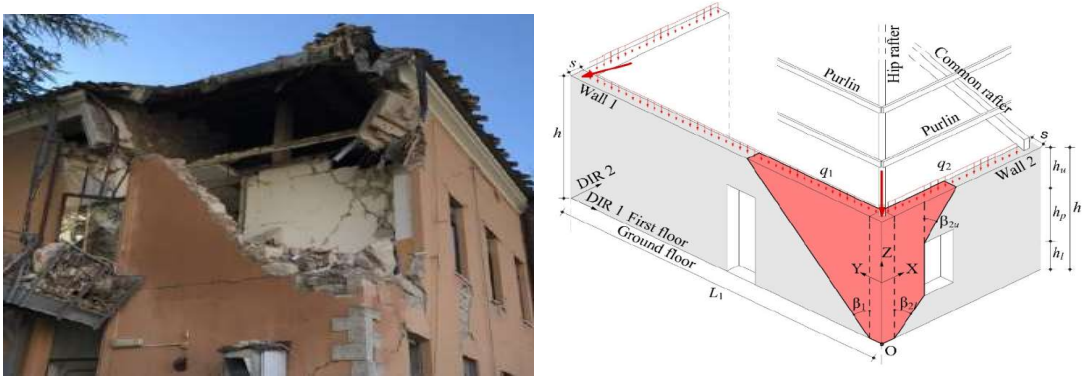

Figure 1 – Corner failure

- Analysis of innovative retrofitting systems to prevent local out-of plane mechanisms, e.g.:
  - injected anchors with pultruted composite bars (GRFP, CFRP, etc.) and different

kinds of grout as pozzolana, lime based or cement-based grout to reinforce wall connections (Fig. 2);

- laminates or FRP fabrics used as confinement systems of columns or mounted at each floors or at the last floor along the perimeter of the building (Fig. 3).

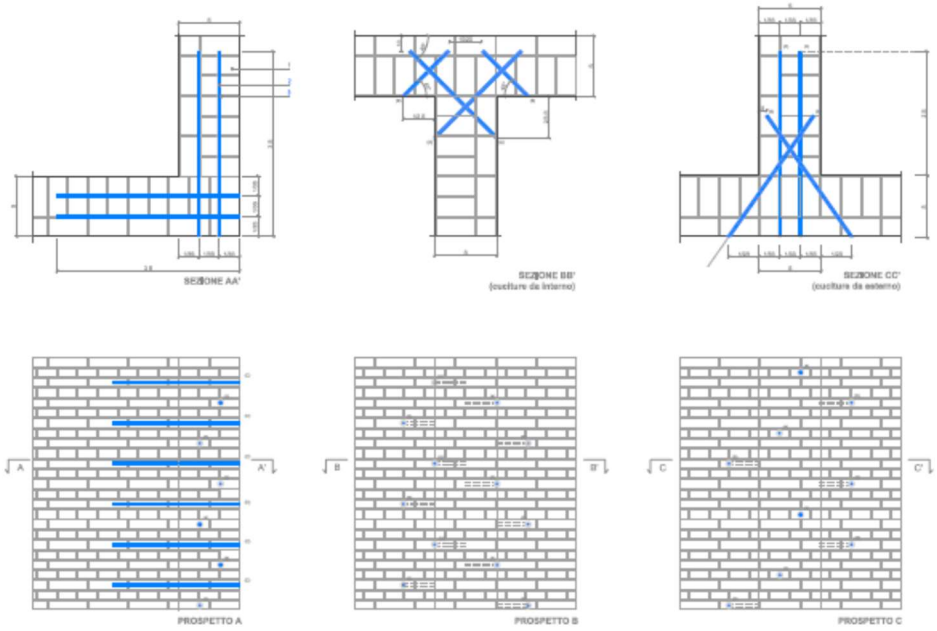

Figure 2

Figure 3

- Development of FE models on the basis of existing experimental tests in order to compare analytical and experimental findings and to calibrate proper relations to describe the non linear behavior of the masonry material and the interaction between the reinforcement systems and the substrate; for injected anchors, for example, this

deals with the relations governing the bond at the interfaces grout/bar and grout/masonry wall.

Experimental tests on sub-assemblages of walls with and without the reinforcement with composite injected anchors and FRCM materials, aimed at defining the activation of some recurrent mechanisms and the capacity curves in terms of force-displacement through monotonic and cyclic tests.

6. Pubblicazioni sul tema di ricerca – Relevant publications

- A. Maione, **C. Casapulla**, F. Ceroni, M. Di Ludovico, A. Prota (2021). Efficiency of injected anchors in connecting T-shaped masonry walls: a modelling approach. *Construction and Building Materials*, under 2th round review.
- **C. Casapulla**, L.U. Argiento, A. Maione, Elena Speranza (2021). Upgraded formulations for the onset of local mechanisms in multi-storey masonry buildings using limit analysis. *Structures*, 31: 380-394.
- **C. Casapulla**, A. Maione, L.U. Argiento (2019). Performance-based seismic analysis of rocking masonry façades using non-linear kinematics with frictional resistances: a case study. *International Journal of Architectural Heritage*, doi: 10.1080/15583058.2019.1674944
- **C. Casapulla**, L. Giresini, L.U. Argiento, A. Maione (2019). Nonlinear static and dynamic analysis of rocking masonry corners using rigid macro-block modelling. *International Journal of Structural Stability and Dynamics*, 19(11): (1950137) 1-32.
- L. Giresini, **C. Casapulla**, R. Denysiuk, J. Matos, M. Sassu (2018). Fragility curves for free and restrained rocking masonry façades in one-sided motion. *Engineering Structures,* 164: 195-213.
- **C. Casapulla**, A. Maione, L.U. Argiento, E. Speranza (2018). Corner failure in masonry buildings: an updated macro-modeling approach with frictional resistances. *European Journal of Mechanics - A/Solids*, 70: 213-225.
- **C. Casapulla**, L.U. Argiento (2018). In-plane frictional resistances in dry block masonry walls and rocking-sliding failure modes revisited and experimentally validated. *Composites Part B: Engineering*, 132: 197-213.
- **C. Casapulla**, L.U. Argiento (2016). The comparative role of friction in local out-of-plane mechanisms of masonry buildings. Pushover analysis and experimental investigation. *Engineering Structures*, 126: 158-173.
- **C. Casapulla**, F. Portioli (2016). Experimental tests on the limit states of dry-jointed tuff blocks. *Materials and Structures*, 49(3): 751-767.

- M. Gilbert, **C. Casapulla**, H.M. Ahmed (2006). Limit analysis of masonry block structures with non-associative frictional joints using linear programming. *Computers and Structures*, 84(13-14): 873-887.

7. Progetti di ricerca finanziati in cui l'attività si inserisce – Relevant funded research projects

- PRIN 2017 - Innovative Systems for the UpgRade of MasOnry structUres and Non sTructural elements (SURMOUNT). Principal Investigator: Prof. Andrea PROTA
- ReLUIS 2019-2021 Italian Civil Protection Research Project
- Other projects will start in 2022

8. Fondi disponibili per eventuali assegni, borse di ricerca, ecc., per acquisto eventuale di attrezzature, missioni – Available funds

The same projects above will provide funds for salaries and activities

9. Informazioni relative ad un periodo di ricerca all'estero (minimo tre mesi) previsto per il dottorando – Information on the research stage abroad (at least three months) for the Ph.D.

The PhD student will spend a minimum of 3 months at one of the following universities, collaborating with the tutor in several research activities:

- The University of Sheffield (UK. Reference Professor: **Matthew Gilbert**
- Institute for Sustainability and Innovation in Structural Engineering (ISISE), University of Minho (Portugal). Reference Professor: **Paulo B. Lourenço**
- University College London (UK). Reference Professor: **Dina D'Ayala**
- Budapest University of Technology and Economics (Hungary). Reference Professor: **Katalin Bagi**

10. Eventuali collaborazioni con imprese/aziende sul tema di ricerca – Collaborations with companies on the research topic

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Napoli,_14/04/2021 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 30/04/2021**.