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

XXXVI CICLO

La sottoscritta prof. Claudia CASAPULLA

(PO □ PA □ RU x RTD □) afferente al Dipartimento di Strutture per l'Ingegneria e l'Architettura, S.S.D. 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)

Claudia CASAPULLA (female, MSc in 1997 and PhD in 2000) is an Aggregate/Assistant Professor in Structural Engineering (with awarded national scientific qualification as Associate Professor) at the University of Napoli Federico II and Staff Member Responsible (SMR) for Laboratories, Courses and Modules of Structural Engineering at the host university (Bachelor and Master levels).
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, form 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) (managed budget: about 40.000€) 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 (total managed budget: about 100.000€). 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, managed budget: about 170.000€). 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 University of Sheffield (UK) and Minho (PT).
Her expertise in training programs is attested by her involvement as academic tutor in orientation and training internships for students, in supervising research fellows and Ph.D. students (including a MSc. SAHC 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 course 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 approximately 30 indexed international journals, associate editor and co-founder of the International Journal of Earthquake and Impact Engineering, editorial board member of 8 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).
Bibliometric indicators SCOPUS: 688 Citations, h-index = 18; GOOGLE SCHOLAR: 1123 Citations, h-index = 22.

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

no. 2	*1) 2016-2019. Co-Tutor of Piera Salzano, XXXII Cycle of the Ph.D. in "Fenomeni e Rischi Ambientali" (FERIA) – University of Napoli "Parthenope". Title of the Thesis: "Vulnerability assessment of historical masonry churches". First Co-Tutor: Francesca Ceroni* *2) 2018-2021. Co-Tutor of Thomas Celano, XXXIV Cycle of the Ph.D. in "Fenomeni e Rischi Ambientali" (FERIA) – University of Napoli "Parthenope". First Co-Tutor: Francesca Ceroni*

3. Titolo della ricerca proposta

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

4. Area tematica

Ingegneria Geotecnica □

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)

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), 69, pp. 1-19.
[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, pp. 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, pp. 328-343.
[4] Ceroni, F., Cuzzilla, R., Pecce, M. (2016). *Assessment of performance of steel and GFRP bars as injected anchors in masonry walls*. Construction and Building Materials 123, pp. 78-98.

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.

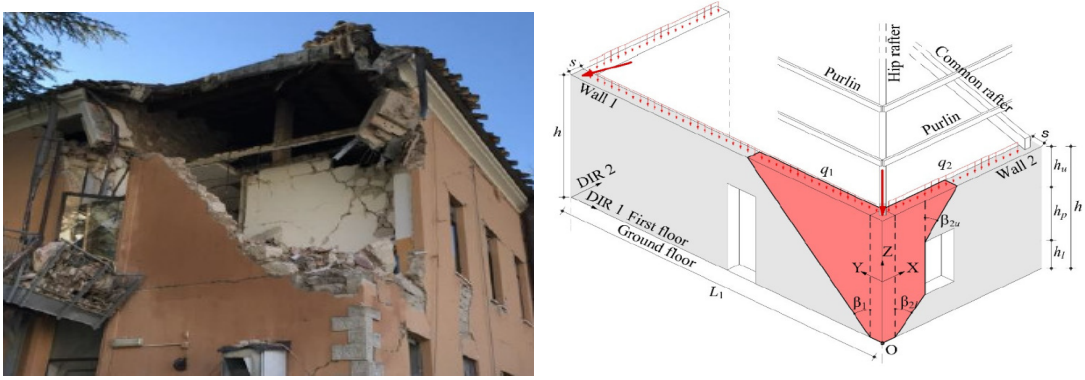

Figure 1 – Corner failure

- 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).

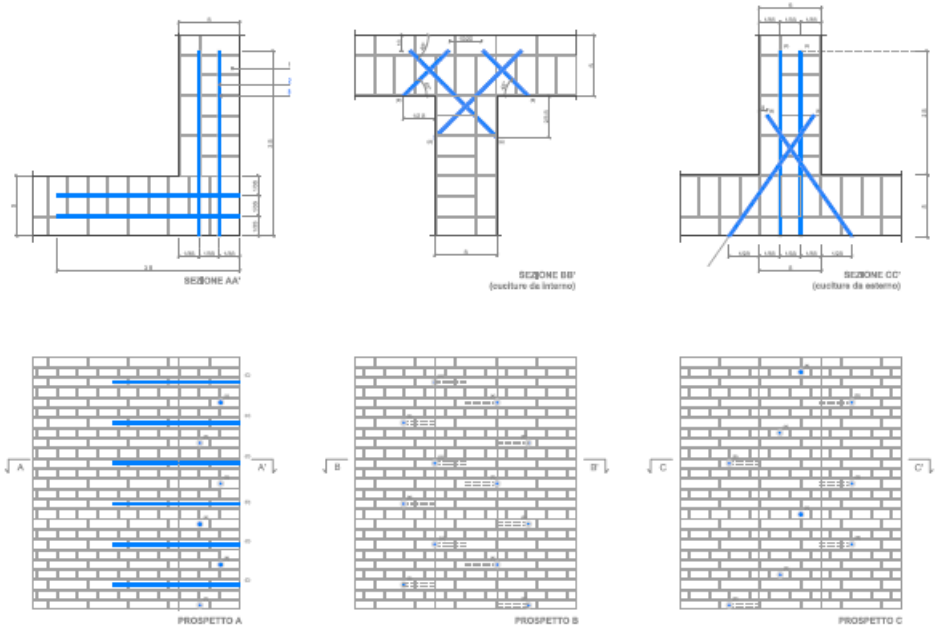

Figure 2

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

1) 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, ISSN: 15583058, doi: 10.1080/15583058.2019.1674944

2) 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), p. (1950137)1-32, ISSN: 02194554, doi: 10.1142/S0219455419501372

3) C. Casapulla, A. Maione (2018). Experimental and analytical investigation on the corner failure in masonry buildings: interaction between rocking-sliding and horizontal flexure. INTERNATIONAL JOURNAL OF ARCHITECTURAL HERITAGE, doi: 10.1080/15583058.2018.1529206

4) L.U. Argiento, A. Maione, C. Casapulla (2018). Formulating the in-plane frictional resistances and collapse mechanisms for multi-storey masonry block walls. FRATTURA ED INTEGRITÀ STRUTTURALE 46, p. 226-239, ISSN: 19718993, doi: 10.3221/IGF-ESIS.46.21

5) 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, p. 195-213, doi: 10.1016/j.engstruct.2018.03.003

6) 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, p. 213-225, ISSN

09977538, doi: 10.1016/j.euromechsol.2018.03.003

7) 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, p. 197-213, ISSN: 1359-8368, doi: 10.1016/j.compositesb.2017.09.013

8) 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, p. 158-173, ISSN: 0141-0296, doi: 10.1016/j.engstruct.2016.07.036

9) C. Casapulla, F. Portioli (2016). Experimental tests on the limit states of dry-jointed tuff blocks. MATERIALS AND STRUCTURES 49(3), p. 751-767, ISSN: 1359-5997, doi: 10.1617/s11527-015-0536-3

10) M. Gilbert, C. Casapulla, H.M. Ahmed (2006). Limit analysis of masonry block structures with non-associative frictional joints using linear programming. COMPUTERS & STRUCTURES 84(13-14), p. 873-887, ISSN: 0045-7949, doi: 10.1016/j.compstruc.2006.02.005

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

PRIN 2017 - Innovative Systems for the UpgRade of MasOnry structUres and Non sTructural elements (SURMOUNT). Principal Investigator: Prof. Andrea PROTA

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

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)

Institute for Sustainability and Innovation in Structural Engineering (ISISE), Department of Civil Engineering, University of Minho Campus de Azurém, 4800-058 Guimarães, Portugal, www.isise.net
Reference Professor: Paulo B. Lourenço, e-mail: pbl@civil.uminho.pt

The proponent is currently undertaking research activities with Prof. Paulo B. Lourenço of the University of Minho (PT). The most recent joint activities are related to the modeling and safety assessment of the Santa Maria Maddalena Church in the Ischia Island (NA, Italy), for which the proponent was the consultant of the Campania Regional Directorate for Cultural Heritage (MiBACT) for the provisional safety interventions after the 2017 Ischia earthquake. This church is a very interesting case study of tuff masonry originally strengthened with an atypical iron "baraccato" system of the late 19th century.
The joint collaboration allowed the development of a MSc. SAHC thesis and a Ph.D. stage, both supervised by Profs. Lourenço and Casapulla. The MSc. thesis was developed by Beatrice Di Napoli, now working at the ISISE Institute, while a research stage of 6 months was taken by Thomas Celano, Ph.D. student from the University of Napoli "Parthenope".
Similarly, a minimum of 3-month stage will be arranged within the proposed Ph.D. Program. The doctorate student will work under the guidance of Prof. Lourenço, in close interaction with the Historical and Masonry Structures postdoctoral and doctoral staff. ISISE will provide a working place and access to the laboratories, together with a printing and internet infrastructure, for the purpose of the visit.

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

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Napoli, 09.02.2020 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**.