

Research Group

Structural and sEismiC safety of strategic and relevant existing constrUctions: buildings and bRidgEs [SECURE]

Reference year:

2025

Scientific Coordinator:

DE MATTEIS Gianfranco / Full Professor / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

Group members:

DE MATTEIS Gianfranco / Full Professor / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

ZERLENGA Ornella / Full Professor / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

FAELLA Giuseppe / Full Professor / Dipartimento di Architettura e Disegno Industriale/ University
of Campania “Luigi Vanvitelli”

CENNAMO Claudia / Associate Professor / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

FRUNZIO Giorgio / Associate Professor / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

GUADAGNUOLO Mariateresa / Associate Professor / Dipartimento di Architettura e Disegno
Industriale/ University of Campania “Luigi Vanvitelli”

SERRAGLIO Riccardo / Associate Professor / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

D’APRILE Marina / Assistant Professor (RTI) / Dipartimento di Architettura e Disegno
Industriale/ University of Campania “Luigi Vanvitelli”

CHISARI Corrado / Assistant Professor (RTD-B) / Dipartimento di Architettura e Disegno
Industriale/ University of Campania “Luigi Vanvitelli”

ZIZI Mattia / Assistant Professor (RTD-A) / Dipartimento di Architettura e Disegno Industriale/
University of Campania “Luigi Vanvitelli”

BENCIVENGA Pasquale – Assistant Professor (RTD-A)

DI GENNARO Luciana / PhD

DELL’AVERSANO Costantino / Research fellow

IOVINELLI Giulio / Research fellow

DI RIENZO Noemi / PhD Student

ADEEL ZEB Mirza / PhD Student

Description of research lines:

1 – Structural and seismic safety of monumental buildings

The research line deals with studies aimed at the seismic vulnerability assessment and protection of historical constructions. Through the identification of the prevailing historical-architectural and constructive characteristics, the main fragilities related to the behavior of structures are recognized. The developed methodology is aimed at: (i) planning territorial strategies for the mitigation of seismic risk, capable of ensuring adequate performance levels of structures; (ii) experimenting by devices and intervention techniques (including the ones innovative and based on innovative technologies) capable of extending their residual life, in full respect of the architectural value of the assets considered

2- Structural and seismic safety of strategic and relevant buildings

The notable ancientness characterizing the existing Italian building heritage is generally one of the main causes, together with the absence of far-sighting handling policies in the last decades devoted to the protection and conservation, of the seismic vulnerability affecting the existing buildings. This peculiarity affects also strategic and relevant buildings. In this wide set of building typologies are included also hospitals and schools (according to regional laws enacted after OPCM n.3274 dated 20/03/2003). This research line is aimed at the mitigation of the seismic risk that is relevant for these structures also due to their significant exposure. In particular, the studies within this research line address the implementation of large-scale assessment methodologies to simulate damage scenarios for supporting the definition of intervention priority. This is developed in collaboration with competent authorities (e.g. ASL of Campania region and Ministry of Instructions), as well as actively participating in national research projects (Agreement DPC-ReLUIIS 2022-24, WP4.6 Maps and seismic risk scenario of schools and hospitals).

3- Structural and seismic safety of existing road bridges

This research line focuses on the notable national problem of safeguarding the existing infrastructural heritage and in particular road bridges. With the recently enacted Italian “Guidelines for the classification, risk management, safety assessment and monitoring of existing bridges” (2022), unified multi-level procedures for the protection of such a constructional typology have been promoted. Such a procedure entails different detail levels: from the census of the structures to the accurate safety assessment of existing bridges. In this context, in collaboration with the FABRE Consortium and the Province of Caserta, the research group develops several activities supporting the main national handling bodies (e.g. ANAS Spa, Autostrade per l’Italia Spa) for the application of these procedures and the supervision of assessment and design activities. Moreover, this research line includes the different activities focused on the monitoring of existing bridges and the implementation of advanced survey methodologies for special structures (e.g. bridges with prestressed reinforced concrete elements with post-tensioned wires).

4- Structural and seismic safety of existing masonry arch bridges

A significant portion of the existing infrastructural asset consists of masonry arch bridges realized in the first decades of the last century on the basis of empirical criteria rather than rational and analytical approaches. The significant increase of vehicular traffic (both in terms of vehicles/day and weight of vehicles) subjects such in-service structures to work rates significantly higher than, in some cases, can lead to structural failure. This holds true also due to the fact that these centenary existing masonry arch bridges have overpassed their service life and thus are in critical conservation

states. Moreover, as it is well-known, being these structures based on the static principle of the arch and realized with a no tensile resistant material (masonry), the occurrence of exceptional events (e.g. earthquake) can represent an even more significant hazard situation for their safety and operativity. Based on this, this research line focuses on the implementation of assessment and retrofitting methodologies for existing masonry arch bridges, also accounting for damaged and defective configurations. The studies developed within this research line include research aimed at implementing both assessment and retrofitting methodologies by means of integrated approaches including the survey, the characterization, the numerical modelling and the proposal of sustainable and efficient structural enhancement solutions.

Relationships with other research groups of the University of Campania L. Vanvitelli during the last three years:

The members of the research group had (or still have) relationships with the following research groups:

- **Standard-FA** of the Department of Architecture and Industrial Design and with the Structure Laboratory of the Department of Engineering.
- **Drawing, Survey, Representation, Structure, Communication of cultural heritage of the Department** of Architecture and Industrial Design and with the Structure Laboratory of the Department of Engineering
- **The form of Architecture and Design in the settlements, in the landscape and in the inner space** of the Department of Architecture and Industrial Design and with the Structure Laboratory of the Department of Engineering
- **The Memory of Sites. History and Preservation for promoting the environmental and architectural heritage (MemoS)** of the Department of Architecture and Industrial Design and with the Structure Laboratory of the Department of Engineering
- **Zero Energy Building towards Zero Embodied Energy Building (ZEB twd ZEEB)** of the Department of Architecture and Industrial Design
- **Political, legal e sociological profiles of phrenological research in Italy**, of the Department of Politic Sciences
- **Gems and Jewelry: History and Design.** of the Department of Architecture and Industrial Design

Participation in research projects during the last three years:

Title of the project: GESTIONE del rischio SISmico per la valorizzazione turistica dei centri storici dei Mezzogiorno – GENESIS (codice progetto ARS01_00883)

Principal Investigator: Prof. Enrico Spacone, Università degli Studi di Chieti-Pescara

Program title: Avviso del 13/07/2017 “Presentazione di progetti di ricerca industriale e sviluppo sperimentale nelle 12 aree di Specializzazione individuate dal PNR 2015-2020”

Description of the research project activities: The main objectives of the research concern the development of a computer platform for the collection of information on the historical-cultural heritage, aimed at the simulation of damage scenarios for the management of emergency situations (territorial scale); at the planning of interventions for the reduction of seismic risk (urban scale); at the development of structural behavior models for the evaluation of static safety and seismic vulnerability as well as the interventions that may be necessary according to the previous analysis (building scale).

Involved staff: Gianfranco De Matteis (Scientific Coordinator of Research Unit)

Partner institutions: Proposed by Università degli Studi G. D'Annunzio di Chieti.

Academic Partners: Università degli Studi della Campania Luigi Vanvitelli, Università degli Studi dell'Aquila, Università degli Studi della Basilicata, Università degli Studi Mediterranea di Reggio Calabria, Università degli Studi di Enna Kore, Università Iuav di Venezia, Università degli Studi di Bergamo, Università di Pisa

Industrial Partners: Tab Consulting S.r.l. TAB Consulting, Asdea S.r.l. ASDEA, Zugaro Guido & C. S.r.l., Target Euro S.r.l., Kibernetes S.r.l., FIP Industriale S.P.A., PRO.GE.77 S.r.l., SISIA S.r.l. SISIA, BOVIAR S.r.l., Consorzio C.i.p.a.e. A R.l., BASF S.r.l., TELENIA S.r.l., Etna Hitech S.c.P.A., Fibre Net S.r.l.

State of the project: funded

Submission date/Start/End of the project: 09-11-2017/01-01-2023/30-06-2025.

Title of the project: Evaluation of structural vulnerability and innovative intervention methods for the protection of masonry historical constructions of Italian infrastructural heritage (CUP: B61B21005470007)

Principal Investigator: Prof. Gianfranco De Matteis

Program title: Programma Operativo Nazionale Ricerca e Innovazione 2014-2020

Description of the research project activities: The research activities deal with the development of methodologies for the structural vulnerability assessment of historical masonry constructions. In particular, the methodologies refer to infrastructural constructions (bridges) and address the problem following both a large-scale and a single-construction approach. The activities entail: i. the development of methodologies for the structural vulnerability assessment at a large scale; ii. vulnerability assessment methodologies by means of Finite Element Models; iii. the proposal of innovative, low-invasive and reversible retrofitting techniques.

Involved personnel: Mattia Zizi, Gianfranco De Matteis

Partner institutions: Fabre Consortium

State of the project: Positively evaluated/funded/finished

Starting/closing date: ---/01-01-2022/31-12-2024

Title of the project: Structural Assessment Framework of historical masonry towers and bridges to Enhance RESidual life – SAFE_RES

Scientific Coordinator: Prof. Gianfranco De Matteis

Program title: PRIN 2020

Description of the research project activities: The SAFE_RES project will develop a comprehensive strategy for the large-scale investigation, assessment and retrofitting of historical masonry towers and arch bridges to enhance their conservation and operativity by extending their residual life.

Involved personnel: Corrado Chisari, Giorgio Frunzio, Mariateresa Guadagnuolo, Pasquale Bencivenga, Jafar Rouhi.

Partner institutions: Politecnico of Milano, University of Udine, University of Catania, University of Padova

State of the project: not funded

Submission date: 01/2021

Title of the project: Advanced procedures for SAFETy assessment of existing Masonry Arch Bridges – SAFE_MAB

Principal Investigator: Mattia Zizi

Call title: Bando di selezione per il finanziamento di progetti di ricerca fondamentale ed applicata dedicato ai giovani ricercatori

Description of the research activities of the project: The SAFE_MAB project will focus on existing Masonry Arch Bridges (MABs) by means of a multidisciplinary approach involving the scientific disciplines of Structural Engineering (ICAR/09), Structural Mechanics (ICAR/08) and Drawing (ICAR/17). The main aims of the SAFE_MAB project proposal are to identify the defects mostly influencing the capacity in facing external loads of MABs and to propose innovative methodologies for their survey.

Involved Staff: Mariateresa Guadagnuolo (CO-PI), Corrado Chisari, Giorgio Frunzio, Pasquale Bencivenga, Luciana Di Gennaro

Partner institutions: ---

State of the project: Positively evaluated/funded/ongoing

Submission date/Start/End of the project: 08-07-2022/03-10-2022/02-01-2024

Title of the project: STARES

Principal Investigator: Dott. Arch. Vincenzo Cirillo

Call title: Bando di selezione per il finanziamento di progetti di ricerca fondamentale ed applicata dedicato ai giovani ricercatori

Description of the research activities of the project: STARES will investigate masonry staircases using inter-disciplinary state-of-art criteria, techniques, and tools for the preparation of knowledge models useful for critical analysis, recovery, and enhancement of the asset.

Involved Staff: Corrado Chisari, Ornella Zerlenga, Pasquale Bencivenga

Partner institutions: ---

State of the project: eligible/funded/finished

Submission date: 08/07/2022 - 09/2023 – 04/2024.

Title of the project: DAMAGES

Principal Investigator: Dott. Eng. Paolo Zampieri (University of Padova)

Call title: PRIN 2022 PNRR

Description of the research activities of the project: DAMAGES project is aimed at advancing scientific knowledge in the assessment of existing masonry arch bridges subjected to exceptional environmental actions by: (i) improving comprehension of causes-effects processes that induce complex damage scenarios in masonry bridges; (ii) defining adequate constitutive models for the description of the nonlinear behaviour of masonry material accounting for pre-existing degradation, which will include probabilistic approaches to consider the non-deterministic nature of the mechanical properties of the constituents and the uncertainty in the distribution/localization of damage; (iii) developing effective assessment strategies for damaged masonry bridges up to collapse to investigate the evolution of safety level.

Involved Staff: Corrado Chisari (co-PI)

Partner institutions: University of Padova and University of Perugia

State of the project: submitted/not funded

Submission date: 30-11-2022.

Title of the project: High-performance materials for sustainable structures

Principal Investigator: Prof. Vincenzo Piluso (University of Salerno)

Call title: PRIN 2022

Description of the research activities of the project: The resistance of the material and the related

structural performances is no more sufficient in performance evaluation, as soon as other issues need to be included, such as those related to sustainability. In this research project, the attention is focused on the performance evaluation of stainless steel and aluminium alloys including cradle-to-gate and gate-to-site environmental performances, structural performances in terms of exhibited ultimate resistance and ductility, the resulting greenhouse emissions of structures as affected by the required safety levels and the life-cycle behaviour as affected by the corrosion resistance.

Involved Staff: Gianfranco De Matteis (Coordinator of the research unit), Mariateresa Guadagnuolo

Partner institutions: University of Campania “Luigi Vanvitelli”, University of Padova, University of Catania

State of the project: submitted/not funded

Submission date/Start: 27-03-2022.

Title of the project: Structural Assessment and development of innovative saFEguard Measures fOr hisTORical masONry towers_SAFEMOTION

Principal Investigator: Prof. Gianfranco De Matteis

Call title: PRIN 2022-PNRR

Description of the research activities of the project: SAFE_MOTION aims at developing innovative techniques and methods for investigation, assessment and retrofitting of historical masonry towers, in order to enhance their conservation, use, fruition and to extend their residual life. To reach the objective, complementary expertise of the research units will be provided, namely in the fields of dynamic monitoring, identification and damage assessment, numerical modelling, structure testing and retrofitting design.

Involved Staff: Giorgio Frunzio, Mariateresa Guadagnuolo

Partner institutions: University of Padova, University of Udine

State of the project: eligible/funded/ongoing

Submission date: 30-11-2022 / 1-02-2024 / 31-01-2026

Title of the project: TRAILED-LAB: Un Laboratorio Mobile a Servizio dei Comuni del Cratere

Principal Investigator: Prof. Giuseppe Brando, University “G. d’Annunzio” of Chieti-Pescara

Call title: Avviso per la selezione di progetti di promozione della ricerca, del trasferimento tecnologico e della formazione universitaria da finanziare nelle regioni Lazio, Abruzzo, Umbria e Marche interessate dagli eventi sismici del 2016

Description of the research activities of the project: “TRAILED-LAB” is a new research centre integrating mobile facilities for in-situ measurements of materials, structures and infrastructures, with fixed standard facilities. TRAILED-LAB aims at providing an advanced instrument for supporting reconstruction and decision-making processes, for both assessments of recovery interventions for seismically damaged buildings and infrastructures and addressing the choices on the re-use of construction materials of collapsed buildings.

Involved Staff: : Gianfranco De Matteis, Giorgio Frunzio, Corrado Chisari, Mariateresa Guadagnuolo, Mattia Zizi

Partner institutions: University “G. d’Annunzio” of Chieti-Pescara, University of Camerino, National Institute of Geophysics and Vulcanology -INGV

State of the project: eligible/funded/ongoing

Submission date: 25-02-2022/ 1-12-2023 / 30/11/2026.

Title of the project: L’ospedale Storico come bene sociale e come patrimonio culturale

Principal Investigator: Prof. Fabio Mangone (Università Federico II di Napoli)

Call title: PRIN 2020

Involved Staff: Marina D'Aprile

State of the project: not funded

Submission date: 01-2021.

Title of the project: "Green Ways. Wissensrouten und Netzwerke zwischen Orten mit besonderen regionalen, historischen und kulturellen Prägungen" [Green Ways. Percorsi di conoscenza e reti ecosostenibili tra luoghi dal particolare valore storico e culturali]

Principal Investigator: Prof. Karin Lehmann (Università delle Scienze Applicate di Bochum)

Call title: Dialogue with South Europe 2021 / Hochschuldialog mit Südeuropa 2021 (Dialogo universitario con il Sud Europa)

Description of the research activities of the project: Based on the proven German experiences in the fields of green economy and sustainable tourism and accounting for the recent COVID-19 pandemic event, the research focuses on the study of historic-architectonic itineraries for "knowledge paths" able to enhance the recognition and fruition of the "memory of places", triggering virtuous mechanisms of revaluation of local economies.

Involved Staff: Marina D'Aprile

Partner institutions: ---

State of the project: Positively evaluated/funded/ongoing

Submission date/Start/End of the project: ---/01-01-2021/31-12-2022.

Title of the project: Il patrimonio storico degli spazi della salute in Campania: un modello per il recupero e la valorizzazione ecologica e inclusiva dei beni culturali a funzione assistenziale

Principal Investigator: Prof. Fabio Mangone (Università Federico II di Napoli)

Call title: PRIN 2022

Description of the research activities of the project: The research aims to study in a multidisciplinary, multiscale and multisectoral key, the historical structures for care, assistance and hospitality with continuity of function. The objective is to define specific operational protocols for the recovery, reuse and enhancement, able to condense the right to the architectural heritage with that to health and hospitality, taking into account the modalities of hospitalization, summarize the continuity of role with the preservation of architectural and artistic values, in a current cultural, regulatory, performance, ecological and inclusive.

Involved Staff: Marina D'Aprile

Partner institutions: ---

State of the project: presentato

Submission date: 27-03-2022.

Title of the project: Thermal Heritage for Ecosustainable Regeneration, Mobility and Economy

Principal Investigator: Dott. Monica Esposito

Call title: Bando di selezione per il finanziamento di progetti di ricerca fondamentale ed applicata dedicato ai giovani ricercatori

Description of the research activities of the project: The research aims to define a strategy of valorization of the anthropized territories of Campania, in particular those characterized by degradation and prolonged abandonment, through the integrated and compatible reuse of natural and cultural resources.

Starting from the history of the territory, together with the analysis of its socio-economic and

cultural characteristics and its material and intangible values, the thermal system of Campania will be studied as a possible engine of future policies to enhance the territory, with a view to sustainable development.

Involved Staff: Marina D'Aprile, Riccardo Serraglio

Partner institutions: -

State of the project: Positively evaluated/funded/ongoing

Submission date/Start/End of the project: 08-07-2022/10-2022/01-2024

Title of the project: Artificial Intelligence to assess the structural/seismic Damage to historic heritage in BIM environment (AIDaBIM)

Principal Investigator: Claudia Casapulla (University of Naples Federico II)

Call Title: PRIN 2022 PNRR

Description of the research activities of the project: The project's purpose is to create a new digital tool for the semi-automatic assessment of damage in order to aid in the preservation and management of the built heritage, particularly masonry churches that have structural issues. This will be implemented through the use of advanced digital technologies, such as building information modelling (BIM) and artificial intelligence (AI). Additionally, a novel approach is put forth to digitise the process of the observed structural damage to churches and to establish quick, accurate assessments of the associated damage states. The generated data will be gathered in a database that can potentially be implemented in DaDO, an Italian Civil Protection platform of observed building damage.

Involved staff: Ornella Zerlenga (Responsible of Research Unit)

Partner institutions: -

Status: Submitted

Submission date: 11-2022

Project title: Inaccessible religious architecture. A workflow of knowledge, 'expanded' usability and 'inclusive' accessibility (EX-IN_AccessIBILITY)

Principal Investigator: Vincenzo Cirillo

Call title: PRIN 2022

Description of the research activities of the project: The project proposes to investigate the religious architectural heritage of the city of Naples (Italy) to transform the condition of inaccessibility of some assets into a renewed accessibility, with the preparation of 'expanded' fruition systems (physical and virtual) capable of enhancing the user experience with multi-sensory input design. Through the definition of a theoretical framework of taxonomy of the inaccessibility of the investigated context, the project will identify scenarios that re-insert religious architectures in the circle of possible experiences in situ, determining a virtuous effect on the local economy and on the regeneration of the contexts of membership. In particular, the expected result is the encoding of an operational workflow for 'inclusive' accessibility and 'expanded' usability of religious architecture even during the implementation of safety measures (provisional works).

Among the impacts of the research, there is the possibility of adopting the operational workflow for other classes of cultural heritage for the acquisition of future funding for enhancement interventions.

Involved staff: Ornella Zerlenga

Status: Submitted

Submission date: 03-2022

Title of the project: WRENCH - Whispers of Time: Heritage as Narratives of Climate-Change

Principal Investigator: Prof. Marco Armiero (Autonomous University of Barcelona)

Call title: Collaborative Research Action (CRA) - Climate & Cultural Heritage (CCH) 2023

Description of the research activities of the project: WRENCH aims to address the effects of climate change on tangible and intangible heritage, while broadening the understanding of heritage to include narratives, narratives, and ephemeral legacies. WRENCH envisions cultural heritage as both something at risk and something that can tell a story about the risk we are all taking. WRENCH has the dual objective of (a) developing a transdisciplinary methodology involving environmental sciences, engineering and humanities to investigate the impact of climate change on tangible and intangible heritage; (b) use heritage as a storytelling tool to improve awareness of climate change.

Involved Staff: Corrado Chisari (Local Principal Investigator), Gianfranco De Matteis, Mattia Zizi, Michelangelo Scorpio, Sergio Sibilio

Partner institutions: Autonomous University of Barcelona (PI), Durham University, Orta Dogu Teknik Universitesi, Hidromod, Durham Castle, Diocesi di Ragusa - Chiesa Madre Duomo di San Giorgio, Consorzio "Coop4Art"

State of the project: eligible/approved/ongoing

Submission date: 08-09-2023/30-06-2024/--

Project Title: Geometric Equilibrium of Stone Structures

Scientific Coordinator: Prof. Claudia Cennamo

Call for Proposals Title: Call for proposal for the funding of fundamental and applied research projects dedicated to researchers not recipients of other funding

Research Activities Description: Current computational formulations in continuous elastic mechanics are often inconsistent with the study of historical architectures, which were built using methods and materials that did not consider elasticity concepts. To model and study such structures coherently, this project proposes a formulation based on the principles of the relationship between form and equilibrium, emphasizing stability and geometry rather than strength. In other words, the goal is to recover Vitruvian principles of *firmitas*, *utilitas*, and *venustas* and transfer them into a contemporary approach to numerical analysis. To achieve this, it is essential to recognize that historical architecture should be interpreted according to specific classical architectural typologies (arches, vaults, domes, trilithons, architraves, pillars, etc.), rather than following the theory of continuous elasticity as traditionally taught in classical literature. Starting from the study of curved structures, the project aims to assess their efficiency from a geometrical-structural perspective, also considering the presence of damages and defects as factors that reduce performance, whose quantification is complex a priori. In this context, the identification of arches and vaults along the Campania coastline as typological invariants can serve as a starting point for the study. The "choral" value of spontaneous architecture and its integration into the landscape, with the purity of its volumes and the constructive logic of its vaults, seem to anticipate the principles of functional architecture, asserting the cultural precedence of Mediterranean architecture over European rationalism.

Involved staff: Giorgio Frunzio, Carolina De Falco, Fabiana Forte, Mariateresa Guadagnuolo, Luciana Di Gennaro, Luigi Massaro, Luca Damiani

Partner institutions: Department of Engineering, University of Campania "Luigi Vanvitelli"

State of the project: Eligible, not funded

Submission/Start/End Dates: 15-03-2024 / -- / --

Scientific products of the last three years:

Scientific publications on Class A journals and/or indexed in the Scopus/WoS databases:

- [1] Chisari, C., Cacace, D., & De Matteis, G. (2022). A mechanics-based model for simplified seismic vulnerability assessment of masonry bell towers. *Engineering Structures*, 270. <https://doi.org/10.1016/j.engstruct.2022.114876>
- [2] Chisari, C., Macorini, L., Izzuddin, B.A. (2022). An anisotropic plastic-damage model for 3D nonlinear simulation of masonry structures. *International Journal of Numerical Methods in Engineering*, 1-27. doi:10.1002/nme.7162
- [3] Guadagnuolo M., Aurilio M., Nuzzo M., Faella G., (2022). Historic chimney stacks: seismic assessment and kinematic analysis, *Journal of Architectural Engineering*, ASCE. doi.org/10.1061/(ASCE)AE.1943-5568.0000571.
- [4] Pantò, B., Chisari, C., Macorini, L., & Izzuddin, B. A. (2022). A hybrid macro-modelling strategy with multi-objective calibration for accurate simulation of multi-ring masonry arches and bridges. *Computers & Structures*, 265, 106769. <https://doi.org/10.1016/J.COMPSTRUC.2022.106769>
- [5] Simoncello, N., Zampieri, P., Zizi, M., Rossi, L., & Pellegrino, C. (2022). Lateral response of damaged stand-alone arches: Tilting tests and rigid-block analysis. *Engineering Structures*, 268, 114700. <https://doi.org/10.1016/J.ENGSTRUCT.2022.114700>
- [6] Zerlenga, O., Cirillo, V. (2022). The Main Staircase of Palazzo Spinelli di Laurino in Naples. Function, Shape, Geometry. In Ródenas-López, M.A., Calvo-López, J., Salcedo-Galera, M. (Eds), *Architectural Graphics. EGA 2022*. Springer Series in Design and Innovation (pp. 405-414). Cham: Springer. ISBN: 978-3-031-04632-2.
- [7] Zizi, M., Bencivenga, P., & De Matteis, G. (2023). Handling policies for Italian existing bridges with a territorial approach: the case study of Caserta, Italy. *Structures*, 48, 1306–1321. <https://doi.org/10.1016/J.ISTRUC.2022.12.114>
- [8] Zizi, M., Chisari, C., Rouhi, J., & De Matteis, G. (2022). Comparative analysis on macroscale material models for the prediction of masonry in-plane behavior. *Bulletin of Earthquake Engineering*, 20(2), 963–996. <https://doi.org/10.1007/s10518-021-01275-x>
- [9] D'Aprile M. (2024), Conservazione delle aree urbane e cambiamento climatico: pratiche di conoscenza e soluzioni operative. *RA. Restauro archeologico*, 33(2), 278-281.
- [10] Zizi, M., Chisari, C. & De Matteis, G. (2024). Effects of pre-existing damage on vertical load-bearing capacity of masonry arch bridges. *Engineering Structures*, 300, 117205. <https://doi.org/10.1016/j.engstruct.2023.117205>

Additional 10 scientific products:

- [1] Chisari, C., Zizi, M., Rouhi, J., Lavino, A. & De Matteis, G. (2022). Ambient Vibration Testing and model updating of the bell tower of St. Michele Arcangelo Cathedral in Casertavecchia, Italy. In *Proceedings of XIX ANIDIS Conference, Seismic Engineering in Italy*. 11-15 September 2022, Torino, Italy
- [2] Frunzio G, Guadagnuolo M, Massaro L, Di Gennaro L. The CLT panels: a sustainable response for existing buildings. In: Gambardella, C. (Ed.). (2022). *BEYOND ALL LIMITS*. International Conference on Sustainability in Architecture, Planning, and Design: Proceedings Book of Extended Abstracts, 250-254.
- [3] Guadagnuolo M., Di Gennaro L., Basile A., De Matteis G., (2022). Simplified methods for the evaluation of mechanical properties of tuff masonry walls in Campania (Italy), XIX Convegno

Ingegneria sismica in Italia, Torino, Italy, September 11-15, 2022.

- [4] Guadagnuolo M., Faella G., Frunzio G., Massaro L., Brigante D., (2022). The capacity of FRP anchors in concrete and masonry structures, XIX Convegno Ingegneria sismica in Italia, Torino, Italy, September 11-15, 2022.
- [5] Zizi, M., Chisari, C. & De Matteis G. (2022). Three-dimensional numerical modelling of multi-span masonry arch bridges under seismic loading. XIX ANIDIS Conference, Seismic Engineering in Italy. 11-15 September 2022, Torino, Italy.
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- [7] M. D'Aprile, *Riuso e conservazione di luoghi eterotopi tra tutela e sostenibilità* in M. Citro (a cura di), *Raffaello visita le carceri di Salerno. Progetto d'Arte Sociale*, Paguro Ed., Salerno, pp. 55-108, ISBN: 979-12-80259-71-4 (contributo in volume, capitolo o saggio).
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Relationships with international and national Companies, Institutions, Research Centers, Universities during the last three years:

- The research work is linked with the research activities connected with the ReLUIIS project DPC 2019-2021, concerning: WP2 (Inventory of existing structural and building types - CARTIS); WP4 (Risk maps and seismic damage scenarios - MARS); WP12 (Regulatory relating to civil and industrial steel construction). Lead scientist: Prof. Gianfranco De Matteis
- Fabre Consortium “Research consortium for evaluation and monitoring of bridges, viaducts and other structures” for scientific and research activities related to the survey and assessment of existing road bridges. Lead scientist: Prof. Gianfranco De Matteis
- Autostrade per l'Italia S.p.A., for collaboration and research activities in the field of infrastructural engineering related to highway network handled by ASPI. Lead scientist: Prof. Gianfranco De Matteis.
- Dioceses of Sessa Aurunca, for scientific support in the definition of structural aspects aimed to the realization of the new bell tower of the Santi Pietro e Paolo Cathedral in Sessa Aurunca. Lead scientist: Prof. Gianfranco De Matteis.
- Istituto Nazionale Tumori IRCCS – Fondazione Pascale, for support, coordination, supervision and review of seismic vulnerability assessment of buildings of handled buildings. Lead scientist: Prof. Gianfranco De Matteis.
- Azienda Ospedaliera di Rilievo Nazionale Sant’Anna e San Sebastiano of Caserta, for support, coordination, supervision and review of seismic vulnerability assessment of buildings of handled buildings. Lead scientist: Prof. Gianfranco De Matteis.
- Azienda Ospedaliera “Ospedali Dei Colli”, for support, coordination, supervision and review of



seismic vulnerability assessment of buildings of handled buildings. Lead scientist: Prof. Gianfranco De Matteis.

- Azienda Ospedaliera dell'Università degli Studi della Campania "Luigi Vanvitelli", for support, coordination and supervision and review of activities aimed to seismic and structural safety of handled buildings. Lead scientist: Prof. Gianfranco De Matteis.
- Agreement for research activities: Department of Civil Engineering, University of Salerno [Delibera del C.di Dip. n. 13 del 17/12/2020]. Lead scientist: Dott. Eng. Corrado Chisari
- Agreement for research activities with "Laboratorio TecnoLab srl - Construction Materials Testing Laboratory" in Naples. Lead scientist: Dott. Arch. Mariateresa Guadagnuolo
- London Metropolitan University: Dott. Arch. Marina D'Aprile.
- CREATURE – Research Centre in Creative Arts, Culture and Engagement: Dott. Arch. Marina D'Aprile.
- Valletta Higher Education Institute: Dott. Arch. Marina D'Aprile.
- Comune di Mercato San Severino (SA): Dott. Arch. Marina D'Aprile.
- Universidad de Alcalá Facultad, Escuela Técnica Superior de Arquitectura. Departamento de Arquitectura, Alcalá de Henares (Spain): Prof.ssa Arch. Ornella Zerlenga.
- Universidad Politécnica de Cartagena, Escuela Técnica Superior de Arquitectura y Edificación: Prof. Arch. Ornella Zerlenga.
- Universidade de Lisboa, Faculdade de Arquitectura. Departamento de Artes, Humanidades e Ciências Sociais, Lisboa (Portugal): Prof. Arch. Ornella Zerlenga.
- Universitat de les Illes Balears (UIB), Higher Polytechnic School (Spagna): Prof. Arch. Ornella Zerlenga.
- University of Applied Sciences, Hochschule Koblenz (Germania): Prof. Arch. Ornella Zerlenga.
- SIRA - Società Italiana per il Restauro dell'Architettura - membro del Direttivo per il triennio 2024-2026 – Dott. Arch. Marina D'Aprile;
- ASL Caserta - U.O.C. Tecnico Patrimoniale e Manutenzione Immobili Territoriali e Direzione Generale – Dott. Arch. Marina D'Aprile;
- OperAzione S.r.l. -Società edile (Napoli) – Dott. Arch. Marina D'Aprile
- Cankaya University, Ankara (Turchia) – Dott. Arch. Marina D'Aprile
- Complesso delle Basiliche di Cimitile, Nola (NA) – Dott. Arch. Marina D'Aprile
- MUMAC - Museo Multimediale delle Acque Campane, via Romani 3 - Sant'Anastasia (NA) – Dott. Arch. Marina D'Aprile
- S.A.V.E. - Saverio Carillo APS, Associazione culturale - Nola (NA) – Dott. Arch. Marina D'Aprile

Collaborations with Consortia, Scarl or other Institutions participated by the University of Campania L. Vanvitelli during the last three years:

- Consortium FABRE “Research Consortium for assessment and monitoring of bridges, viaducts and other structures.” (Consortium members: ENEA, University of Camerino; University of Campania “Luigi Vanvitelli”; University of Messina; University of Padova; University of Perugia; University of Pisa; Polytechnic of Milano; Polytechnic of Torino). Prof. Gianfranco De Matteis is Coordinator of the activities of the Consortium for the University of Campania “Luigi Vanvitelli”, Member of Consortium Scientific Committee and Member of the Consortium Executive Board.

ISI Web of Science Subject Categories:

- Engineering, Civil
- Engineering, Mechanical
- Material Science, Characterization & Testing
- Material Science, Composite
- Construction & Building Technology

Scientific-Disciplinary Sectors:

CEAR-06/A
CEAR-07/A
CEAR-10/A
CEAR-11/A
CEAR-11/B

Keywords:

Strategic Buildings
Cultural Heritage
Bridges
Seismic Safety
Structural Safety
Masonry
Reinforced Concrete
Structural Enhancement
Seismic Enhancement
Retrofitting Technique

ERC Categories:

PE8_3: Civil engineering, maritime/hydraulic engineering, geotechnics, waste treatment
PE8_4: Computational engineering
PE8_12: Sustainable design (for recycling, for environment, eco-design)
PE8_16: Architectural engineering
SH5_6: History of art and architecture, arts-based research
SH5_7: Museum, exhibitions, conservation and restoration
SH5_8: Cultural studies, cultural identities and memories, cultural heritage