Short Curriculum vitae

S I R O C A S O L O
Born in Udine, living in Milano.

- Full Professor (Structural Mechanics: 08/B2, ICAR08), Politecnico di Milano from 8 November 2018

Previously:
- Associate Professor (Structural Mechanics: 08/B2, ICAR08), Politecnico di Milano from 1 May 2005 to 7 November 2018;
- Assistant Professor (Structural Mechanics :08/B2, ICAR08), Politecnico di Milano from 1 March 2001 to 30 April 2005;
- Research Assistant, Politecnico di Milano from 1 March 1999 to 28 February 2001;
- Short service agreement contract as a Researcher, International Centre for Theoretical Physics (ICTP – Trieste) from 1 giugno 1997 to 31 dicembre 1997;
- PhD in Ingegneria sismica, Politecnico di Milano (1994-1996);
- Degree in Ingegneria Civile (Maximum grade cum Laude), Università di Udine;
- High school Scientific qualification, Liceo Scientifico Niccolò Copernico, Udine.

OTHER ACADEMIC APPOINTMENTS AND REPRESENTATIVE ASSIGNMENTS:
- Visiting professor during the period November-December 2010 at Instituto de Ingenieria, UNAM Ciudad de Mexico.
- Member of the External Commitee (EEC) for the evaluation – accreditation process of the Department of Architecture of University of Cyprus (10-13 December 2019).
- Member of the faculty of the PhD in "Architecture, Built Environment and Construction Engineering", at Politecnico di Milano, 29th-34th cycles.
- Member of the faculty of the PhD in "ARCHITECTURAL" at Politecnico di Milano, 27th cycle.
- Member of the faculty of the PhD in "CIVIL ENGINEERING, ENVIRONMENT AND LAND, BUILDING AND CHEMISTRY", at Politecnico di Bari, 27th cycle.
- Member as researchers representative in the Executive of the Faculty of Civil Architecture for the biennium 2001/2003 academic year, from April 5, 2002.
- Member of the Board of the Department of Structural Engineering (DIS), elected for the period 2009-2011 as a representative of the Associate Professors. Contact person for the computing resources and network.
- Head of the research entitled "Development and optimization of a calculation code for dynamic modeling rigid elements of monumental buildings", banished under the Rector's Decree No. 57/AG of June 12, 2006. Duration of the grant: 12 months (October 2006 - September 2007).
- Head of the research entitled: "Vulnerability assessment of masonry buildings in the historic centers. Mechanical analysis and adoption of algorithms easily ", banished under the Rector's Decree No. 667/AG of February 28, 2011, as amended by D.R. No 911/AG of March 30, 2011. Duration of the grant: 12 months (December 2011 - November 2012).

MAIN FIELDS OF RESEARCH:
The research has been developed in the frame of two main fields: [A] Computational mechanics of solids and [B] Dynamic and seismic analysis of structures.

[A]: Computational Mechanics of Solids.
Research in this field has been developed following a point of view fundamentally discrete, developing an original "rigid body-springs modelling" (RBSM) finalized to the macroscopic description of the constitutive laws of heterogeneous masonry-like solids. The plane solid cases of modelling, out-of plane (Casolo, 1999), and in-plane (Casolo, 2004) have been considered. The focus was on obtaining a computational tool aimed at the efficient resolution of the dynamic step-by-step analysis, with hysteretic behavior and damage of material, by adopting the appropriate simplifications from time to time (Casolo & Peña, 2007; Casolo, 2009).
In the case of out-of-plane behavior, the material response laws are orthotropic and macroscopically attributed, on a phenomenological basis, derived on the basis of characteristic values at the level of elementary fibre (Casolo, 2000). A recent development consisted in also taking into account the effects of different geometrical quality of the masonry texture, also considering the multi-leaf case, in combination with the weight (Casolo & Milani, 2010; 2013).
The constitutive relations for the case of materials with regular-periodic in-plane texture has been obtained from an analysis focused on the meso-scale. The core concept of in-plane model is therefore in the definition of a "heuristic molecule" which consists of four quadrilateral rigid masses connected in pairs by a shear-spring and two axial-springs (Casolo, 2006 and 2009). The approach has proved effective for transferring the essential mechanical properties that depend on the geometry of the internal texture, while adopting a macro-scale model that requires very small number of degrees of freedom. It is shown that this discrete model is associated with a characteristic internal length related to the size of the heterogeneous

elements of the periodic texture. In addition, the characteristics of polarity and orthotropic shear response of this model can be put in relation to an orthotropic Cosserat continuum. Following a heuristic approach, this model has been has been also applied to study global dynamic response with degradation of strength and stiffness of different monumental masonry buildings (Casolo & Sanjust, 2009; Milani et al. 2012; Casolo et al. 2013). More recently, the RBSM has been employed to study some glass structures that are characterized by a very brittle behavior (Biolzi et al. 2017; Biolzi at al. 2019).
A recent line of research in this field regards the peridynamic approach, initially applied to the study of a glass beam (Casolo & Diana, 2018) and to a classic problem of stress concetration (Ballarini et al. 2018). Then, an enhanced bond based model has been developed for the isotropic and orthotropic response with arbitrary Poisson's ratios (Diana & Casolo, 2019a, 2019b).
The most recent research line, based on the concept of "heuristic molecule", regards the development of an innovative and new approach to design the topology of meta-materials with prescribed unusual elastic properties, strongly auxetic and/or chiral (Casolo, 2021).
The proposed models are always implemented in a series of original computer codes, mainly written in Fortran language, to solve the elastic-plastic boundary problem.

[B]: Dynamic and seismic response of buildings.
The modelling the dynamic behavior of realistic buildings is the main test field of the computational models described above. This branch of my research activity has been stimulated by the survey and reflections about the seismic behavior of specific typological classes of masonry structures. Very specific and simplified fibre models, with 1, 2 and 3 degrees of freedom, were initially developed to solve the dynamics of masonry towers with different degrees of slenderness (Casolo et al. 1994; Casolo, 1998). For the case of out-of-plane dynamics of masonry churches façades, a relatively simple constitutive law, widespread in the commercial computer codes, has been proposed in (Casolo et al. 2000).
Then, the original RBSM code has been extensively applied for investigating the seismic response of slender church façades as well as for the complex system of thrusting arches (Casolo et al. 2000; Petrini & Casolo, 2002), as well as the request to study the seismic vulnerability of some specific monuments (Casolo & Sanjust 2007, 2009). Monumental buildings such as the Maniace Castle and the Cathedral of Syracuse, has been studied by an integrated modelling, at different scales, in order to analyse both the global and the partial response of their complex structures. Different approaches have thus been employed in the field of seismic analysis of historic buildings, through both push-over and dynamic analysis (Casolo & Sanjust, 2007; Casolo et al. 2007; Casolo & Sanjust, 2009; Casolo et al. 2012; Milani et al. 2012; Casolo et al. 2013; Casolo et al. 2017). An innovative experimental test has been presented in (Casolo et al. 2019) to characterize the orthotropic shear response of a regular masonry wall. These applications allow to critically compare the various provisions of seismic codes, which are in force and/or proposed in recent years (Casolo & Uva, 2013; Sferrazza Papa et al. 2020; Uva et al. 2020). The most innovative models proposed in the field of computational mechanics, as in the case of the "heuristic molecules" approach, have been applied to the field of seismic dynamics of towers to deepen the study of effective damage patterns (Casolo, 2021).
Another aspect of this line of research concerns the study of the destructive potential of forcing actions, particularly seismic, with the aim of characterizing the forcing actions through simple parameters taken from the time histories (Casolo, 2001). Regarding the characteristic of ground motions, some other studies on the spectral type evolution of volcanic tremors were also made purely for purposes of forecast (Casolo et al. 1996). The study of the cumulative damage to masonry structure due to a sequence of strong ground motion has also been investigated in the dynamical field (Casolo, 2017).
Finally, in the field of seismic behaviour of buildings and risk mitigation, another research line consists in the survey and vulnerability assessments at the urban scale of the historic centre of the city of Foggia in addition to the three municipalities of its province, in collaboration with the respective municipalities and Provincial administration (Uva et al. 2016).

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MAIN SCIENTIFIC PUBBLICATIONS:

- Casolo S. (2021). A linear-elastic heuristic-molecular modelling for plane isotropic micropolar and auxetic materials. *International Journal of Solids and Structures*, vol. **224**, p. 1-17, ISSN: 0020-7683, doi: 10.1016/j.ijsolstr.2021.111042
- Casolo S. (2021). Macroscale modelling of the orthotropic shear damage in the dynamics of masonry towers by RBSM. *Engineering Failure Analysis*, vol. 105744, p. 1-21, ISSN: 1350-6307, doi: 10.1016/j.engfailanal.2021.105744
- Sferrazza Papa, G., Tateo, V., Parisi, M. A., Casolo, S. (2021). Seismic response of a masonry church in Central Italy: the role of interventions on the roof. *Bulletin of Earthquake Engineering*, vol. **19**, p. 1151-1179, ISSN: 1570-761X, doi: 10.1007/s10518-020-00995-w

- Uva G., Tateo V., Casolo S. (2020), “Presentation and validation of a specific RBSM approach for the meso-scale modelling of in-plane masonry-infills in RC frames”. *International Journal of Masonry Research and Innovation*, 5(3), 366-395. ISSN: 2056-9459, doi: 10.1504/IJMRI.2020.107995
- Casolo S., Biolzi L., Carvelli V., Barbieri G. (2019), “Testing masonry blockwork panels for orthotropic shear strength”. *Construction and buildings materials*, **214**, 74-92, ISSN: 0950-0618, doi: 10.1016/j.conbuildmat.2019.04.116
- Biolzi L., Casolo S., Orlando M., Tateo V. (2019), “Modelling the response of a laminated tempered glass for different configurations of damage by a rigid body spring model”, *Engineering Fracture Mechanics*, **218**, 1-14, ISSN: 0013-7944, doi: 10.1016/j.engfracmech.2019.106596
- Diana V., Casolo S. (2019), “A full orthotropic micropolar peridynamic formulation for linearly elastic solids”, *International Journal of Mechanical Sciences*, **160**, 140-155, ISSN: 0020-7403, doi: 10.1016/j.ijmecsci.2019.06.036.
- Diana V., S. Casolo (2019), “A bond-based micropolar peridynamic model with shear deformability: Elasticity, failure properties and initial yield domains”, *International Journal of Solids and Structures*, **160**, *201-231*, - https://doi.org/10.1016/j.ijsolstr.2018.10.026.
- Casolo S., V. Diana (2018), “Modelling laminated glass beam failure via stochastic rigid body-spring model and bond-based peridynamics”, *Engineering Fracture Mechanics*, **190**, 331-346 - https://doi.org/10.1016/j.engfracmech.2017.12.028.
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- Bertolesi E., G. Milani, & S. Casolo (2018), “Homogenization towards a mechanistic Rigid Body and Spring Model (HRBSM) for the non-linear dynamic analysis of 3D masonry structures”, *Meccanica* **53**(7), pp. 1819-1855. https://doi.org/10.1007/s11012-017-0665-6
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- S. Casolo (2017), “A numerical study on the cumulative out-of-plane damage to church masonry façades due to a sequence of strong ground motions”, *Earthquake Engineering and Structural Dynamics*, **46** (15), pp. 2717-2737. - DOI:10.1002/eqe.2927
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- Uva G., Sanjust C.A., Casolo S., Mezzina M. (2016), “The ANTAEUS Project for the Regional Vulnerability Assessment of the Current Building Stock in Historical Centres”, *International Journal of Architectural Heritage*, **10**(1), 20-43. - doi**:**10.1080/15583058.2014.935983
- Porco F., Fiore A., Casolo S. (2014), “Comparisons between seismic retrofitting solutions for existing reinforced concrete buildings: A case study”, *International Journal of Structural Engineering*, **5**(3), 242-261. - doi:10.1504/IJSTRUCTE.2014.063035
- Casolo S., Milani G., Uva G., Alessandri C. (2013), "Comparative seismic vulnerability analysis on ten masonry towers in the coastal Po Valley in Italy ", *Engineering Structures*, **49**, 465-490, Elsevier Science Ltd, ISSN: 0141-0296
- Casolo S., G. Uva (2013), "Non-linear analysis of out-of-plane masonry façades: Full dynamics vs. pushover methods by RBSM", *Earthquake Engineering and Structural Dynamics*, **42**(4), 499-521 John Wiley & Sons Ltd, ISSN: 0098-8847. - doi:10.1002/eqe.2224
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- Casolo S., Milani G., Sanjust C.A., Taliercio A. (2012), "Maniace castle in Syracuse, Italy: Comparison between present structural situation and hypothetical original configuration by means of Full 3D FE models", *The Open Civil Engineering Journal*, **6**, 173-187 Bentham Science Publishers B.V,, ISSN: 1874-1495, doi: 10.2174/1874149501206010173
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- Casolo S., Milani G. (2010), "A simplified homogenization-discrete element model for the non-linear static analysis of masonry walls out-of-plane loaded", *Engineering Structures*, **32**(8), 2352-2366, Elsevier Science Ltd, ISSN: 0141-0296. - doi: 10.1016/j.engstruct.2010.04.010
- Casolo S., Uva G. (2010), "Risposta sismica fuori del piano di facciate in muratura: confronto tra analisi dinamiche non-lineari e analisi pushover", *Ingegneria Sismica*, Anno **XXVII** - N.3 pagg. 33-54, Pàtron editore, Bologna.
- Casolo S., Sanjust C.A. (2009), "Seismic analysis and strengthening design of a masonry monument by a rigid body spring model: the Maniace Castle of Syracuse", *Engineering Structures*, **31**(7), 1447-1459, Elsevier Science Ltd, ISSN: 0141-

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- Casolo S., Neumair S., Parisi M. A., Petrini V. (2000), "Analysis of Seismic Damage Pattern in Old Masonry Church Façades", *Earthquake Spectra*, **16**(4), 757-774, ISSN: 8755-2930.
- Casolo S. (2000), "Modelling the out of plane seismic behaviour of masonry walls by rigid elements", *Earthquake Engineering and Structural Dynamics*, **29**(12), 1797-1813, John Wiley & Sons Ltd, ISSN: 0098-8847.
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- Casolo S. (1998), "A Three Dimensional Model for Vulnerability Analyses of Slender Masonry Medieval Towers", *Journal of Earthquake Engineering*, **2**(4), 487-512, Imperial College Press, ISSN: 1363-2469.

SUPERVISOR OF PhD THESIS:

- Fernando Peña, "*Rigid element model for dynamic analysis of in-plane masonry structures*", relatore: prof. V. Petrini, correlatore: ing. S. Casolo, contro-relatore: prof. L. Gambarotta Dottorato di Ricerca in "Ingegneria Sismica", Politecnico di Milano (2001).
- Carlo Alberto Sanjust, "*Modellazione del comportamento dinamico in campo non lineare di edifici in muratura secondo un approccio ad elementi rigidi*", relatore: prof. S. Casolo, co-relatore prof. V. Petrini, contro-relatore: prof. Nicola Zani, Dottorato di Ricerca in "Ingegneria sismica, geotecnica e dell'interazione ambiente-struttura" presso il Politecnico di Milano (ottobre 2005).
- Vito Diana, "*Discrete physically-based models in solid mechanics*" relatore: prof. S. Casolo, Dottorato di Ricerca in "Architecture, Built Environment and Construction Engineering /Architettura, Ingegneria delle Costruzioni e Ambiente Costruito" (marzo 2018).
- Vito Tateo, "*Discrete models and solid mechanics of brittle materials*", relatore: prof. S. Casolo, Dottorato di Ricerca in "Architecture, Built Environment and Construction Engineering /Architettura, Ingegneria delle Costruzioni e Ambiente Costruito", (luglio 2021).