

Personal information and background

prof. ing. FRANCESCO CALVETTI, PhD.



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MSc in Civil Engineering at Politecnico di Milano in 1992.

PhD in Geotechnical Engineering at Politecnico di Torino in 1998.

Academic position at Politecnico di Milano

Associate Professor of Geotecnica (Soil Mechanics, Rock Mechanics and Geotechnical Engineering) at Politecnico di Milano since December 2004.

Rector's Delegate for Sport Activities of Politecnico di Milano since February 2011.

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Current Teaching activity (BSc, MSc, PhD):

Geotecnica (Soil Mechanics): 9 CFU, LM (MSc) in Ingegneria Edile/Architettura.

Soil-structure Interaction: 9 CFU, MSc in Civil Engineering for Risk Mitigation.

Advanced Soil and Rock Mechanics: 6 CFU, MSc in Civil Engineering.

Geotecnica e Tecnica delle Fondazioni (Soil Mechanics and Foundation Engineering): 6 CFU, LM (MSc) in Ingegneria dei Sistemi Edilizi.

Distinct Element Modelling of Granular Materials, Rocks and Stone structures: 5 CFU, PhD-ABC

Other academic tasks

University Tutor for curricular stages, LM in Ingegneria Edile/Architettura.

Past PhD Courses and activities

Distinct Element Analysis of Blocky Systems: course for PhD School of Politecnico di Milano in Architecture, Built Environment and Construction Engineering (2017/18).

Micromechanics of Granular Materials: course for PhD School of Politecnico di Milano in Structural, Seismic and Geotechnical Engineering (2013/14 and 2015/16).

Discrete Element Modelling: course for PhD School of Politecnico di Milano in Environmental and infrastructure Engineering (academical year 2013/14).

Distinct Element approach to Geotechnical Engineering: course for PhD School in Geotechnical Engineering of Universitat Politecnica de Catalunya – UPC, Barcelona (June 2007).

Director of ALERT Geomaterials Doctorate School "Discrete modelling in geomechanics" (Aussois, October 2008).

Lectures for PhD European Schools:

- ALERT Doctorate School (EU): lecture "Distinct element simulation of debris-flows" (Aussois, October 1999);
- Ecole de formation "Modèles numériques en génie civil" of Réseau Doctoral Génie Civil (France): lecture "Eléments distincts: application à la mécanique des matériaux granulaires et aux instabilités" (Aussois, March 2002);
- ALERT Doctorate School "Discrete modelling in geomechanics" (EU): lecture "Modelling of geotechnical engineering problems" (Aussois, October 2008)

Supervised PhD Thesis:

- From 2017 - Modelling of permafrost degradation and gravity-induced risks in Alpine areas (Guodong Wang - PhD School ABC Department, Politecnico di Milano)

Co-Supervised PhD Thesis:

- 2007 - Analisi degli effetti indotti dai fenomeni franosi di flusso rapido (Analysis of the effects of rapid flow landslides, E. Vitolo – Università di Salerno)
- 2012 - Analysis of installation and loading process for displacement piles by Discrete Element model (F. Valentino – Università di Napoli II)

Collaborations with other Italian and European Universities

Supervisor of stages at Politecnico di Milano for PhD students of several Italian Universities (Università di Padova) and European Universities (UJF Grenoble - France, ETH Zurich – Switzerland, UPC Barcelona – Spain):

- 2006 - UJF Grenoble (France). DEM simulation of mechanical behavior of granular materials: Modélisation du comportement mécanique d'un matériau granulaire composite par la méthode des Elements Discrets (C. Salot, UJF Grenoble).
- 2007 - Università di Padova (Italy). DEM modeling of landslides: L'approccio particellare per la modellazione numerica dell'innescamento di instabilità di versante in terreni granulari (Discrete numerical modelling of the triggering of landslides in granular materials, F. Gabrieli)
- 2008 - UPC Barcelona (Spain). Cone penetration tests: DEM Calibration chamber (J. Butlanska)
- 2012 - ETH Zurich (Switzerland). Rockfall impacts: Numerical Simulation of Rockfall Impacts on Cushion Material by Distinct Element Method (C. Roethlin)

Joint research activity with NTU Athens (Greece): DEM modelling of debris flows impacts (corresponding researcher: Emmanouil Vairaktaris).

Joint research activity with UPC Barcelona (Spain): DEM modeling of crushable granular materials (corresponding researchers: Antonio Gens and Marcos Arroyo).

Editorial Activity

Member of "Acta Geotechnica" Advisory board from 2006 to 2015.

Guest Editor of Special Issues of Italian Geotechnical Journal "Mechanics and Physics of Granular Materials" (2003) and "Gravitational flows and Vulnerability of Structures" (2005).

Guest Editor of the Special Issue of the European Journal of Environmental and Civil Engineering "Discrete modelling in geomechanics" (2008).

Reviewer for "Mechanics of cohesive-frictional materials", "Int. J. Numerical and Analytical Methods in Geomechanics", "Int. J. Solids and Structures", "Computers & Geotechnics", "J. Statistical Physics", "Rock Mechanics - Rock Engineering", "Rivista Italiana di Geotecnica", "Engineering Geology", "Géotechnique". Guest Editor of special issues of Rivista Italiana di Geotecnica ("Mechanics and Physics of Granular Materials" and "Gravitational flows and Vulnerability of Structures"), and of European J. of Env. and Civil Eng. ("Discrete Modelling of Geomaterials").

Scientific responsibilities

Head of the Organising committee and Scientific Committee of the 5th Interdisciplinary Workshop on Rockfall Protection - RocExs 2014 (Lecco, May 2014).

Member of Scientific committee of the International Symposium Rock Slope Stability 2016 (Lyon, November 2016).

Scientific responsible of ALERT Geomaterials Workshops "Mechanics and Physics of Granular Materials" (Aussois, October 2001) and "Gravitational flows and Vulnerability of Structures" (Aussois, October 2004).

Member of TC 105 (Geo-Mechanics from Micro to Macro) and TC 103 (Numerical Methods in Geomechanics) of the International Society of Soil Mechanics and Geotechnical Engineering.

Scientific responsibilities and activities in funded projects

Member of the Steering committee of the French National Research Project C2ROP - Chutes de Blocs, Risques Rocheux, Ouvrages de Protection (Rockfall, Rock Risks and Protection Works), Ministry of Environment, Energy and Sea (2015-2020).

Scientific responsibility of Politecnico di Milano unit, GEODIS project "Realistic modeling of geomaterials using Discrete Element Methods" (Projet Région Rhône-Alpes - Emergence 2005).

Scientific responsibility of action "Distinct Element Method" in project PRIN 2010-11: "La mitigazione del rischio da frana mediante interventi sostenibili" (2012-15).

Scientific responsibility of actions "DEM numerical assessment of impact forces of dry granular masses on rigid barriers" and "Distinct Element Modelling of geogrids

pull-out" industrial research project PON01_01869 "Tecnologie e Materiali Innovativi per la Difesa del Territorio e la Tutela dell'ambiente" (2013-16).

Funded Research projects and contracts

2003-2004 "Analysis of the impact of rock blocks on granular layers" for Veneto Strade S.p.A.

2004 "Analysis of tunnels with Finite Differences code FLAC" for Metropolitana Milanese.

2004-2005 "Design of rockfall shelters: geotechnical issues and effects of geosynthetics on the stress propagation" for Veneto Strade S.p.A.

2006 "Rockfall shelters: action assessment and design guidelines" for Veneto Strade S.p.A.

2018 "Distinct Element back analysis of a rockfall event in Sinigo (BZ)" for Incline s.r.l.

2019 "Renovation and assessment of stability of Rifugio Capanna Regina Margherita" for Club Alpino Italiano.

Main research interests and ongoing research

- Design of protection structure for landslides.

Experimental study and numerical simulation of block impacts on granular materials. In situ testing of real scale shelters. Modeling of impact wave propagation and soil-shelter dynamic interaction. Numerical dynamic analysis of the non linear behavior of the shelter. Modelling of the impact of debris-flows on structures.

- Application of the Distinct Element Method to Geotechnical and Rock Engineering problems.

Modelling of soil-structure interaction: soil-pipe interaction, earth pressure on retaining structures, cone penetration tests, rockfall impact on shelters, silo flow. Modelling of landslides: debris flows and rockfalls (triggering, run-out assessment, impact). Weathering induced subsidence and collapses. Seismic triggering of landslides and seismic behavior of blocky structures.

- Micromechanical study of the mechanical behaviour of soils and granular materials in general.

Reproduction of laboratory element tests on sand and soft-rocks, micro-macro correlations, calibration of micromechanical parameters, 2D-3D analogy. Incremental behaviour, non-reversibility, local mechanism of plastic strain. Study of induced anisotropy, localisation, liquefaction. Modelling of hard-soils/soft-rocks, weathering.

- Climate change and Permafrost degradation.

DEM simulation of the mechanical behaviour of ice and frozen soils. Modelling of rock joints filled with ice. Large scale DEM stability analysis of rock slopes in high Alps.

Selected publications (1997-2020)

Scopus statistics: 41 documents, 763 total citations, h-index 14, 86 co-authors.

Wang, G., Calvetti, F. *DEM modelling of ice filled rock joints* (2020), Proceedings 16th IACMAG, pp. 1-8.

Wang, G., Calvetti, F. *DEM Simulation of Frozen Granular Soils with High Ice Content* (2019), Lecture Notes in Civil Engineering, 40, pp. 472-480.

Calvetti, F., di Prisco, C., Redaelli, I., Sganzerla, A., Vairaktaris, E. *Mechanical interpretation of dry granular masses impacting on rigid obstacles* (2019) Acta Geotechnica 14(5), pp. 1289-1305.

Calvetti, F., Frenez, T., Vecchiotti, M., Piffer, G., Mair, V., Mosna, D. *DEM Simulation of the Evolution of an Unstable Rock Face: A Modelling Procedure for Back Analysis of Rockslides* (2018) Rock Mechanics and Rock Engineering, 52(1), pp. 149-161.

Calvetti, F., di Prisco, C., Vairaktaris, E. *DEM assessment of impact forces of dry granular masses on rigid barriers* (2017) Acta Geotechnica, 12 (1), pp. 129-144.

Ciantia, M.O., Arroyo, M., Calvetti, F., Gens, A. *A numerical investigation of the incremental behavior of crushable granular soils* (2016) International Journal for Numerical and Analytical Methods in Geomechanics, 40 (13), pp. 1773-1798. DOI: 10.1002/nag.2503

Ciantia, M.O., Arroyo, M., Calvetti, F., Gens, A. *An approach to enhance efficiency of dem modelling of soils with crushable grains* (2015) Geotechnique, 65 (2), pp. 91-110. DOI: 10.1680/geot.13.P.218

Calvetti, F., di Prisco, C. *Rockfall impacts on sheltering tunnels: Real-scale experiments* (2012) Geotechnique, 62 (10), pp. 865-876. DOI: 10.1680/geot.9.P.036

Gabrieli, F., Lambert, P., Cola, S., Calvetti, F. *Micromechanical modelling of erosion due to evaporation in a partially wet granular slope* (2012) International Journal for Numerical and Analytical Methods in Geomechanics, 36 (7), pp. 918-943. DOI: 10.1002/nag.1038

Arroyo, M., Butlanska, J., Gens, A., Calvetti, F., Jamiolkowski, M. *Cone penetration tests in a virtual calibration chamber* (2011) Géotechnique, 61 (6), pp. 525-531.

Calvetti, F. *Rockfall shelters covered by granular layers: Experiments and design approach* (2011) European Journal of Environmental and Civil Engineering, 15 (suppl.1), pp. 73-100.

Calvetti, F., di Prisco, C. *Discrete numerical investigation of the ratcheting phenomenon in granular materials* (2010) Comptes Rendus - Mécanique, 338 (10-11), pp. 604-614.

Gabrieli, F., Cola, S., Calvetti, F. *Use of an up-scaled DEM model for analysing the behaviour of a shallow foundation on a model slope* (2009) Geomechanics and Geoengineering, 4 (2), pp. 109-122.

Calvetti, F., Di Prisco, C. *Linee guida per la progettazione di gallerie paramassi* (2007) Starrylink, pp. 1-184, ISBN: 978-88-89720-79-0.

Calvetti, F., Di Prisco, C., Vecchiotti M. *Experimental and numerical study of rock-fall impacts on granular soils* (2006) Italian Geotechnical Journal, vol. 39; p. 95-109, ISSN: 0557-1405

Tamagnini, C., Calvetti, F., Viggiani, G. *An assessment of plasticity theories for modeling the incrementally nonlinear behavior of granular soils* (2005) Journal of Engineering Mathematics, 52 (1-3), pp. 265-291.

Calvetti, F., di Prisco, C., Nova, R. *Experimental and numerical analysis of soil-pipe interaction* (2004) Journal of Geotechnical and Geoenvironmental Engineering, 130 (12), pp. 1292-1299.

Calvetti, F. *Limitations and perspectives of the micromechanical modelling of granular materials* (2003) Mathematical and Computer Modelling, 37 (5-6), pp. 485-495.

Havenith, H.-B., Strom, A., Calvetti, F., Jongmans, D. *Seismic triggering of landslides. Part B: Simulation of dynamic failure processes* (2003) Natural Hazards and Earth System Science, 3 (6), pp. 663-682.

Calvetti, F., Crosta, G.B., Tatarella, M. *Numerical simulation of dry granular flows: from the reproduction of small-scale experiments to the prediction of rock avalanches* (2000), Italian Geotechnical Journal, vol. 34(2); p. 21-38, ISSN: 0557-1405

Calvetti, F., Emeriault, F. *Interparticle forces distribution in granular materials: Link with the macroscopic behaviour* (1999) Mechanics of Cohesive-Frictional Materials, 4 (3), pp. 247-279.

Calvetti, F. *Distinct Element evaluation of the rock-fall design load for shelters* (1998) Italian Geotechnical Journal, vol. 32(2); p. 63-83, ISSN: 0557-1405

Calvetti, F., Combe, G., Lanier, J. *Experimental micromechanical analysis of a 2D granular material: Relation between structure evolution and loading path* (1997) Mechanics of Cohesive-Frictional Materials, 2 (2), pp. 121-163.