Fulvio Tonon, Ph.D., P.E.

1. Personal details

LAST NAME:	Tonon
FIRST NAME:	Fulvio
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WEB PAGE:	www.tononeng.com
TITLE 1:	Associate Professor, Geotechnical Engineering
UNIVERSITY ADDRESS:	University of Udine Dept. of Engineering and Architecture Via Cotonificio 114 – 33100 Udine; Italy PH: +39-0432-558252
TITLE 2:	Adjunct Professor
UNIVERSITY ADDRESS:	University of Colorado at Boulder On-line Certificate in Tunneling Dept. of Civil, Environmental, and Architectural Engineering ECOT 441, UCB 428, Boulder, CO 80309-0428 USA
TITLE 3:	Principal Consulting Engineer and Owner
COMPANY:	Tonon USA: Engineering, Measurements, and Testing, LLC
COMPANY ADDRESS:	2028 E Ben White BLVD #240-2660 Austin, TX 78741 PH: +1-512-200-3051
TITLE 4:	Principal Consulting Engineer, and Owner
COMPANY:	Laboratorio Rocce e Ricerca Tonon, SRL
COMPANY ADDRESS:	Via Nazionale 206 38123 Trento, TN, Italy Cell: +39-366-824-9665; Tel: +39-0461-1636349

2. Education

(1)1998-(6)2000 Ph.D. in Civil Engineering, University of Colorado at Boulder. Thesis title: "*Three-dimensional modeling of underground excavations and estimation of boundary conditions in rock with fabric*". Advisor Prof. B. Amadei. Graduate Committee: Profs. B. Amadei, S. Sture, R. Pak, D.M. Frangopol, K.J. Willam, W. Savage.

(10)1989-(10)1995 Degree in Civil Engineering (Laurea), University of Padua (Italy), maximum marks of 110/110 and first-class honors; awarded an honorable mention for the academic study career. Degree thesis title: "*Multiobjective optimization of uncertain structures: a fuzzy set approach with application to the design of tunnel lining in hard rock.*" Prepared at the Department of Structural Mechanics (Istituto di Scienza e Tecnica delle Costruzioni), College of Engineering, University of Padua, under the guidance of Prof. A. Bernardini, A. Mammino and Prof. G. Ricceri.

(9)1984-(6)1989 Maturità Classica (Classical High School), Liceo Ginnasio A. Canova, Treviso, Italy.

3. Registration

Licensed Professional Engineer in Texas, license number 101441, since 2008. Registered Professional Engineer in Italy (Treviso Charter, No. 1793 from 1996 to 2013; Trento Charter N. 3806 from 2013 to present).

4. Professional experience

1996-present:	Professional Engineer. Areas of expertise: geotechnical, tunnel, structural, and bridge engineering. A complete list of projects is given in Section 9.
2000-2002	Senior Tunnel Engineer, Parsons Transportation Group Inc., 1133 15th St. NW, Suite 800, Washington DC 20005-2701. Supervisor Mr. M. Irshad. Areas of expertise: geotechnical, tunnel, structural, and bridge engineering. A complete list of projects is given in Section 9.
1998-2000:	Full-time Research Assistant at the University of Colorado at Boulder. Areas of concentrations: Green's functions for 3D anisotropic media and their incorporation into a BEM formulation, effect of rock mass anisotropy on tunnels, estimation of boundary conditions for rock masses with fabric. Developed collaborations with faculty in different areas and overseas scholars. Organized three seminars with foreign scholars.
(1)1996-(6)1996	Contract researcher for CNR (Italian National Science Foundation). Further researched on non-probabilistic models of uncertainty as applied to Civil Engineering, under the guidance of Prof. A. Bernardini, University of Padua. Further developed collaboration with Prof. I. Elishakoff (Florida Atlantic University), previously started by Prof. A. Bernardini.

5. Current and previous academic experience

July 2017 - Present	Associate Professor of Geotechnical Engineering, University of Udine, Dept. of Engineering and Architecture
Feb. 2014 - Present	Habilitation to Associate Professor in Geotechnical Engineering (Area 08/B1) in Italy.
March 2015-present	Adjunct Professor, Dept. of Civil, Environmental, and Architectural Engineering, University of Colorado at Boulder.
Summer 2012-Spring 2015	Director, On-line Certificate in Tunneling, University of Texas, Austin.
Fall 2005-Summer 2012	Assistant Professor of Geotechnical Engineering, Department of Civil, Architectural and Environmental Engineering, University of Texas, Austin.
Spring 2002 – Summer 2005	Assistant Professor of Geological Engineering, Department of Geology and Geophysics, University of Utah.

6. Experience profile

Dr. Fulvio Tonon earned his Laurea in civil engineering from the University of Padova, Italy, in 1995, and his Ph.D. in civil engineering from the University of Colorado at Boulder, USA, in 2000. He has more than 20 years of professional experience working on projects in the Americas, Europe and Africa. Design experience includes: cut-and-cover and bored tunnels in rock, soft ground and mixed face conditions, with or without the use of Tunnel Boring Machines; foundations and special foundations; rock and soil slope stabilizations; precast concrete and steel-concrete composite bridges; hydraulic infrastructures for dams, purification plants and rivers; renovations of ancient masonry buildings; and reinforced concrete buildings. Fulvio Tonon is Member and Principal Engineer of Tonon USA: Engineering, Measurements and Testing, LLC, and Laboratorio Rocce e Ricerca Tonon, s.r.l.. In these firms, he carries out quality rock testing, provides photogrammetric modeling of tunnels and slopes, and consults in the field of civil engineering. He was a faculty member in the Department of Civil, Architectural and Environmental Engineering at the University of Texas at Austin, and previously he served in the faculty of Geological Engineering at the University of Utah. He spent two years as a senior tunnel engineer with Parsons, and has been a consultant since 1995. He directed the International Tunneling Consortium, which encouraged academic research in response to industrial needs, from the fall 2007 to the summer 2013. He currently develops and directs the On-line Certificate in Tunneling,

which provides working knowledge on tunneling for busy professionals. In 2006, Dr. Tonon won the Award for Applied Rock Mechanics from the American Rock Mechanics Association for his paper entitled: "Stresses in anisotropic rock masses: an engineering perspective building on geological knowledge." His research emphasizes rock mechanics and engineering, underground excavations and uncertainty modeling with generalized theories of probability. He has published two books on tunneling, one book on uncertainty bounds in civil engineering, 66 papers in peer-reviewed journals and 48 papers in conference proceedings. In 2014 he obtained his habilitation as an Associate Professor in Italy in the area of Geotechnical Engineering.

7. Professional memberships and Committees

Associate member of the American Society of Civil Engineers (ASCE), and of the International Association of Bridge Management and Safety (IABMAS). Member of the following institutions: Underground Construction Association (UCA), Italian Tunneling Society (SIG); International Tunneling Association (ITA), American Rock Mechanics Association (ARMA), and International Society of Rock Mechanics (ISRM).

Member of the following committees:

- International Society of Rock Mechanics (ISRM); Maintenance and Repair of Underground Structures in Rock Masses committee (president: L. Ribeiro e Sousa); 2004-2007.
- International Society of Rock Mechanics (ISRM); Rock Fracture Characterization Committee (president: J. Harrison); 2009-present.
- International Tunneling Association (ITA); Committee on Education and Training (chair R. Ghaller); 2008-present. Member of the Executive Board.
- International Tunneling Association (ITA); Working Group 2, Research (animator E. Chiriottia); 2002-present.
- National Academy of Sciences: Underground Geoengineering for Sustainable Development Committee; (chair Paul H. Gilbert) 2010-2012.
- American Association of State Highway and Transportation Officials (AASHTO) Scan Team 09-05, Best Practices for Roadway Tunnel Design, Construction, Maintenance, Inspection, and Operations (K. Thompson, AASHTO Co-Chair, J. Rohena, FHWA Co-Chair).
- American Society of Civil Engineers (ASCE); Geo-Institute Rock Mechanics committee; 2000-present. **Chair**: 2009-2014.
- American Society of Civil Engineers (ASCE); Geo-Institute Risk Assessment and Management committee (coordinator K.-K. Phoon); 2004-present.
- Transportation Research Board (TRB); Committee AFS20, Soils and Rock Instrumentation (chair Thomas C. Sheahan); 2003-2006.
- TRB Committee AFF60, Tunnels and Underground Structures (chair C. Felice); 2005-present. Chair of the Research Subcommittee.
- TRB Committee AFP30, Soils and Rock Properties (chair Silas Nichols); 2003-present.

8. Prizes and scholarships

American Rock Mechanics Association (ARMA): 2006 Award for Applied Rock Mechanics for the paper entitled: Stresses in anisotropic rock masses: an engineering perspective building on geological knowledge. Int. J. Rock Mech. Min. Sci., 40 (2003), 1099–1120.
Awarded the Thesis Prize by the Italian Tunneling Society, Third Edition, for the best thesis on Underground Excavations defended in Italy in the years 1994-95-96.
Awarded scholarships for graduate studies by the following institutions: University of Padua, Italy; University of Pisa, Italy; Fondazione Gini (twice), Padua, Italy; CNR (Italian National Science Foundation); Rotary Foundation (ambassadorial scholarship).

9. Professional projects

Note: the symbol ♦ indicates a project carried out as a consultant on behalf of SIGES (Treviso, Italy); the symbol ♣ indicates a project carried out as a Senior Tunnel Engineer with Parsons Transportation Group (Washington, DC, USA).

9.1 Photogrammetry applications

9.1.1 Underground excavations

1. Inspection of the water tunnel Pian Palù-Cogolo: 1.65-1.9 m diameter, 850 m length, in the presence of high CO_2 concentrations. 3D model of the tunnel lining intrados textured with high resolution photographs and its use for: lining crack identification and change detection (elongation, formation, and enlargement), concrete spalling identification and change detection (formation, enlargement, and deepening), lining strain-stress pattern based on 3D crack survey, and lining displacement. 3D model georeferenced to 1 mm accuracy.
2. Monitoring of the by-pass tunnel in the Helms Pumped Project (CA). Establish and repeat control, and 3D model of the excavation intrados textured with high resolution photographs; overall accuracy (control + 3D model) = 1 mm. Change detection: intrados displacements, lining moisture conditions, and crack elongation, formation, and enlargement. Monitoring is repeated every 3-6 months.
3. Tassullo underground chambers for limestone quarrying and underground storage of Non-Valley apples (Mollaro, TN, Italy). 3D models of the underground excavations textured with high resolution photographs and their use for: detailed fracture mapping and analysis, rock mass classifications, continuous 3D rock mass model along the entire excavation length, 3D geometry and profile check.
4. Cowee rail tunnel (NC). 3D models of the voids created by rock falls at the two ends of the concrete lining.
5. Malus exploratory tunnel for the Brenner Base Tunnel through the Periadriatic Fault (Austria-Italy). Demonstration of: 3D model of the entire excavation heading (face, walls and crown) textured with high resolution photographs and its use for: detailed fracture mapping, continuous 3D rock mass model along the entire tunnel length, point wise shotcrete thickness calculation, profile check, and final lining concrete volume calculations.
6. Inspection of the Liberty roadway tunnel (Pittsburg, PA). Demonstration of: 3D model of the tunnel lining intrados textured with high resolution photographs and its use for: lining crack identification and change detection (elongation, formation, and enlargement), concrete spalling identification and change detection (formation, enlargement, and deepening), lining strain-stress pattern based on 3D crack survey, and lining displacement.
7. Inspection of the Eisenhower-Johnson highway tunnel along I-70 (CO). Demonstration of: 3D models of the air-duct lining intrados and of the roadway tiled revetment, both textured with high resolution photographs and their use for: lining and tile panel displacement identification, identification of the displacements of the air-duct dividing wall (hung from ceiling), lining and tile panel crack identification and change detection (elongation, formation, and enlargement), concrete spalling identification and change detection (formation, enlargement, and deepening), and lining strain-stress patterns based on 3D crack survey.
8. Inspection of the Chesapeake Bay immersed highway tunnel (VA). Demonstration of: 3D models of the air-duct lining intrados and of the roadway tiled revetment, both textured with high resolution photographs and their use for: lining and tile panel displacement identification, lining and tile panel crack identification and change detection (elongation, formation, and enlargement), concrete spalling identification and change detection (formation, enlargement, and deepening), lining strain-stress patterns based on 3D crack survey, and entire tunnel survey of displacements induced by loss of ballast or ballast overloading.

9.1.2 Slopes

1. Survey of a rock face behind former "Italcementi Plant" in Trento, TN, Italy. The rock face, located in an urban area, was about 90 m high and 300 m long. Topographic control, 3D model textured with high resolution photos. This information was then used in a rockfall analysis and in the design of the rockfall mitigation system. Global accuracy of 3 cm obtained from ground stations located 0.2-1.3 km from the rock face.
2. Survey of four ignimbrite (porphyry) quarries in Fornace, TN, Italy. Coverage area = 170 ha (420 ac), topographic control, 20 million faces 3D model textured with high resolution photos, 2.5 cm resolution orthophoto, contour map; 1 cm horizontal accuracy, 1.8 cm vertical accuracy.
3. Rock mass characterization of Mount Brione in Arco, TN, Italy. The rock face was about 270 m high and 2,600 m wide. Topographic control, 3D model textured with high resolution photos, fracture mapping, determination of the dimensions of the rock blocks on the slope and identification of unstable blocks. This information was then used in a rockfall analysis and in the design of the rockfall mitigation system. Global accuracy of 3 cm obtained from ground stations located 1-1.3 km from the rock faces.
4. Rock mass characterization of Rocchetta and Cima SAT rock faces in Riva del Garda, TN, Italy. Each rock face was about 500 m high and 270 m wide. Topographic control, 3D model texture with high resolution photos, fracture mapping, determination of the dimensions of the rock blocks on the slope and identification of unstable blocks. This information was then used in a rockfall analysis for the areas to be developed some 800 m below the toe of the rock faces. Global accuracy of 3 cm obtained from ground stations located 1.8-2.6 km from the rock faces.
5. Monitoring of the Hanging-Lake rock slope along I-70 (CO). Developed entire monitoring scheme and photo acquisition technique for the 500 m high, 1,800 m wide vertical to sub-vertical rock slope in order to achieve 2.5 cm (1 inch) accuracy over the entire slope. The slope is located in a very narrow canyon and it has a very irregular shape (concavities and convexities), which prevent imaging from the ground. 3D model of the slope textured with high resolution photographs and its use to determine slope displacements. Monitoring is repeated every 3-6 months.
6. Monitoring of the De Beque rock slide along I-70 (CO). Established control and developed entire monitoring scheme for the 500 m high, 600 m wide rock slope in order to achieve 1 cm (0.4 inch) accuracy over the entire slope. 3D model of the slope textured with high resolution photographs and its use to determine slope displacements.

9.2 Design and analysis of tunnels and underground excavations

1. Part of the Review Panel for the Director's CD-3A Review of the Long-Baseline Neutrino Facility (LBNF), Conventional Facilities, Underground Excavations. Review of the Preliminary Design for the Detector's facilities 1,500 m (4850 ft) below surface at Sanford Underground Research Facility (formerly Homestake Gold Mine) in Lead, South Dakota, USA. Facilities include 4 caverns (27.4-m or 90-ft high, 20-m of 65-ft wide, 154-m 505-ft long), central utility cavern (11.5-m or 38ft high, 19.5-m or 64 ft wide and 190-m or 624-ft long), 1,200 m (3,871 ft) of new and enlarged access drifts and 953 m (3,125 ft) of mucking ramps.
2. Part of the Expert Review Panel for the 8-km long Scarborough Subway Extension (SSE) Project by the Toronto Transit Commission (TTC), Toronto, Canada. Glacial deposits: overconsolidated silts, sands and clays below the water table. Evaluation of the current design solutions (including 14.1-m, 46-ft single bore with stacked tracks), proposal of alternative solution (10-m single bore with two parallel tracks), risk register.
3. Black and Veatch Review Panel for the 10.8 km-long Jollyville Water Tunnel, Austin, TX. Soft limestone of the Glen Rose formation.
4. Geotechnical and structural analysis and design for a 300-m long drainage tunnel for slope stabilization. Claystone and shale at different degrees of weathering. Lucera, Foggia, Italy. ♦

5. Analysis and design of the rehabilitation of the two-lane Comelico tunnel along a 350-m long tectonic contact between limestone and flysch. Belluno, Italy. ♦
6. Proposal for a new highway in northern Africa: 3 tunnels (3,350+8,200+1,670 = 13,220 m) and four bridges (300+300+350+380 = 1,330 m). Geological and geotechnical proposal for tunnels and bridge foundations, and proposal of construction methods for tunnels. ♦
7. Analysis and shop drawing design for the two-lane Listolade tunnel, Belluno, Italy. Cross-section: 110 m^2; length: 100 m in colluvial detritus + 1,375 m in limestone and 135 m in siltstone. ♦
8. Review of Parsons Water & Infrastructure project for evaluating the repair and replacement alternatives for the T-19 tunnel and the Forebay in granite, part of the Southern California Edison Kern River Number 1 hydroelectric project. Bakersfield, California, USA.
9. Geotechnical and structural analysis and design of five new twin tunnels (each 110 m^2 in cross-section) in fractured limestone and mudstone for the highway Salerno-Reggio Calabria, Italy, contract DG-32. Tunnels: Ospedaletto (length 600 m), Cillarese (length 1000 m), Cerreta (length 750 m), Colloreto (length 150 m), Campotenese 2 (400 m). Special features: intersections and interference between the old and the new tunnels, presence of a high water head in mudstone (Cerreta tunnel), and presence of a valuable monastery over Colloreto tunnel. ♦
10. Geotechnical and structural analysis and design of two new twin tunnels (each 110 m^2 in cross-section) in fractured flysh and limestone for the highway Salerno-Reggio Calabria, Italy, contract DG-8. Tunnels: Sardina II (length 300 m), Costa del Monte (length 600 m). Special features: intersections and interference between the old and the new tunnels, soft shale and shallow cover under inhabited area for Sardina tunnel. Preparation of the geotechnical interpretation and baseline reports for the two tunnels. ♦
11. State Road 77 from Muccia to Colfiorito, Ancona, Italy. Preliminary design and value engineering of 10 km of tunnels for the four alignment alternatives. Geotechnical and structural analysis and final design of the thirteen tunnels for the selected alignment: Brogliano (868 m), Casali (460 m), Faeto (790 m), Castelletto, (970 m), Unnamed (175 m), Serravalle (395 m), Bavareto (750 m), Gelagna (975 m), Massa (550 m), Costafiore (1960 m), Muccia II (590 m), Muccia I (340 m), La Rocchetta (980 m), total 9,803 m. Rock masses: limestone, shale, mudstone, marl. ♦
12. Geotechnical and structural analysis and design for a large underground tuff quarry of Etruscan age (50-200 m in span, 20-30 m in height, 20 m deep) to be transformed into a conference center. Tarquinia, Viterbo, Italy. ♦
13. Geotechnical and structural analysis and design of the diversion tunnels for two earth dams in northern Africa. Internal diameter: 5.5 m; length: 300 m; rock mass: chalk-limestone. ♦
14. Post-Tender design of the Seattle Light Rail Link subway project, WA, USA. Geotechnical and structural analysis and design of the EPB-excavated running tunnel (10 m in internal diameter, 7.5 km in length), 3 mined stations (17 m wide, 14 m high, 120 m long) and shafts (internal diameter from 16 to 36 m) in soft ground under the water table. Special features: deepest subway in the USA (80 m), passage of Portage Bay. ♣
15. La Guardia Airport "N" line extension tunnel feasibility study (New York, NY, USA); 3 km of tunnels and 3 stations in soft ground (glacial sand, varved silt and clay, glacial till, organic silts and clays) under the water table. Development of new, deep profile to avoid organic soil or running sands, and development of construction methods for three deep mined stations, recommendations for the most appropriate tunnel boring machine. Development and spreadsheet implementation of methodologies for ranking different design alternatives. ♣
16. Water intrusion study for the Medical Center crossover cavern (15 m wide, 12 m high, 24 m overburden) on the Subway Red Line, Washington Metropolitan Area Transit Authority (Bethesda, VA, USA). Assessment of the existing condition and development of a monitoring program for the rock reinforcement and cavern lining. Recommendations for the mitigation of the water intrusion problem. ♣

17. Second Avenue Subway Project, New York, NY, USA. Member of the proposal team. Geotechnical and structural study of several design alternatives; study of different tunneling methods and construction methods for the stations. Soft ground, hard rock, and mixed-face conditions. Preparation of man-hour estimates and construction cost estimates. ♣
18. RTD light-rail extension, Denver, CO, USA. Independent check and final design of: outfall tunnel lining and EPBM construction method (diameter 4.5 m, length 400 m through sandstone, sand/gravel, and clay under the water table), transition structure, junction structure, drop shaft, and bridge underpinnings. ♣

9.3 Foundations and special structural and earth works

1. ♠ Design and analysis of a combined sheet-pile wall and micropile retaining system for the construction of new retaining walls in proximity of ancient and delicate masonry buildings in Giudecca Canal, Venice, Italy. Design and analysis of the final retaining wall on micropiles. ♦
2. Analysis and design of 12-m deep tied-back slurry walls and micropile tremie concrete walls for a new building adjacent to 200-year-old stone-masonry buildings in Cortina D'Ampezzo (Belluno, Italy). ♦
3. Geotechnical and structural design of the foundations for a cable-stayed bridge on the Adda river, Italy (span 400 m). ♦
4. Geotechnical and structural, reliability-based design of micropile foundations for a factory in Costa Rica in very loose chaotic soil in seismic zone. ♦
5. Analysis and design of an embankment for a rock trap ditch subjected to impacting rock blocks, in Trento, Italy. ♦
6. Analysis of shallow foundations for a series of high electric towers in Italy. ♦
7. Geomechanical analysis and design of a landfill for municipal waste in seismic zone (Val Organa); construction phases, short term and long term behavior. Cavaso del Tomba, Treviso, Italy. ♦
8. Design and analysis of abutment pile foundations for the new Woodrow-Wilson Bridge between Maryland and Virginia, USA. ♣

9.4 Rock and soil slope stabilizations

1. ♠ Analysis and design of a 6- to 7-m high rock cut in limestone and of its stabilization. The cut was adjacent to an ancient 3-story high masonry house, with distance to the house foundation varying from 20 cm to 3 m. Nago, Trento, Italy. ♦
2. Safety assessment of the current condition, and analysis and design of the stabilization system for a sub-vertical 50-m high rock slope in Condino, Trento, Italy. ♦
3. Slope stability analysis of river embankments for the Po river. Rovigo, Italy. ♦
4. Slope stability analysis for the slope under Bridge 4284 on the Appalachian Corridor H, Section 16, West Virginia, USA. Soft clay overlaying shale deposit. Recommendations for the mitigation of the slope instability threatening the pier foundations. ♣

9.5 Hydraulic infrastructures

1. Structural design and analysis of special reinforced concrete structures (tanks, process basins, etc.) for the purification plant in Asti, Italy. ♦
2. Analysis of the current state, failure causes and technical design documentation relative to the rehabilitation and reconstruction of two earth dams in northern Africa; crest length 500 m, crest height 30 m. Analysis and design of diversion tunnels, grouting and toe galleries, intake towers, and outlet works in seismic zone. ♦
3. Analysis of a dock for the Port of Ancona, Italy, composed of tied-back sheet-pile walls. ♦
4. *In situ* stress measurement program at the Seminoe dam (Wyoming, USA), owned by the US Bureau of Reclamation. The dam was suffering from alcali-aggregate reactions. Recommendations for the

stress analyses to be conducted. Study carried out together with Prof. B. Amadei, University of Colorado at Boulder, USA.

9.6 Bridges

1. Final structural design and shop drawings of a precast, prestressed concrete simply-supported bridge 27-m in span over the Roncajette river, Padova, Italy. Girders, deck, abutments and foundations. ♦
2. Final structural design and CAD shop drawings of a steel-concrete composite viaduct 20-m in width, for the highway Milan-Serravalle (Milan, Italy); tree span (43-74-43 m) continuous bridge: superstructure, abutments, piers and foundations. ♦
3. Analysis of piers and micropile foundations of a prestressed reinforced concrete bridge in seismic zone, close to Pescopagano, Italy. ♦

9.7 Reinforced concrete buildings

Structural design for Ex-Giacetti building, 3 storeys + underground basement. Vicenza, Italy. ♦

9.8 Structural restorations

1. Structural restoration analysis and design of a XV century masonry building called "Mulini Vecchi" in Bassano del Grappa (Vicenza, Italy). ♦
2. Assessment of the current conditions and redesign of the restoration measures for an XVIII century 50-m high masonry bell tower in Bessica di Loria (Vicenza, Italy). ♦

9.9 Expert Witnesses for Court or Dispute Board Use

1. Expert witness for ANAS (Italian National Road and Transportation Agency) relative to a spring intersected by Agnese tunnel in Trento, Italy. Hydrological and hydrogeological study.♦
2. Expert witness for Central Texas Regional Mobility Authority (CTRMA) in a dispute with Contractor CH2M-Hill pertaining to the difficulties encountered by the contractor in microtunneling through Edwards Limestone in Austin, TX, USA. The microtunneling work was used to install drains for the MoPac (Loop 1) Improvement Project: express lanes between Cesar Chavez and Parmer Lane to manage congestion and improve reliability. The expert witness was instrumental in winning the $54 million claim in front of the Dispute Board.

10. Publications

10.1 Books

10.1.1 Co-authored

1) A. Mammino and F. Tonon, (1997); *Opere strutturali per l'ingegneria Territoriale (Structural Works in Geotechnical Engineering Applications), Vol.1 , Tome 2.* Alinea Editrice, Firenze, XLVI + 1431 pages . **Contents**: Introduction; 1. Fundamentals of Fuzzy Set, Random Set and Evidence Theory; 2. Structural Optimization of Uncertain Structures; 3. Geology Applied to Tunneling; 4. Design Parameters for Tunnel Design; 5. Convergence-Confinement Method; 6. Tunnel Lining Optimization; 7. Structurally Controlled Stability of Tunnels; 8. Structural Analysis of Tunnel Linings. (In Italian). ISBN: 88-8125-157-4.
2) A. Mammino and F. Tonon, (1997); *Opere strutturali per l'ingegneria Territoriale (Structural Works in Geotechnical Engineering Applications), Vol.1 , Tomo 3.* Alinea Editrice, Firenze, XLVI + 1065 pages. *Vol.1 , Tome 3.* **Contents:** 9. Tunnels close to a Mountainside; 10. Cut and Cover Tunneling; 11. Concrete Diaphragm Walls; 12. Slope Stability; 13. Special Reinforced Concrete Structures for Hydraulic Networks Nodes; 14. Weirs. (In Italian). ISBN: 88-8125-157-4.
3) Bernardini, A. and Tonon, F. (2010). *Bounding Uncertainty in Civil Engineering – Theoretical Background.* Springer, 350 pages. ISBN: 978-3-642-11189-1.

4) K. Thompson, J. Rohena, A.K. Bardow, B.B. Brecto, B. Khaleghi, L. Ruzzi, M.G. Salamon, F. Tonon, M.L. Ralls, *Best Practices For Roadway Tunnel Design, Construction, Maintenance, Inspection, And Operations*, NCHRP Project 20-68A, Scan 09-05. NCHRP, 186 pages.
5) Committee on Underground Engineering for Sustainable Development (2013). *Underground Engineering for Sustainable Urban Development*. The National Academies Press, Washington, D.C.. ISBN: 978-0-309-27824-9.

10.1.2 Co-edited

1) F. Tonon and J.T. Kottenstette (eds.), (2007); Proc. of the workshop "Laser and photogrammetric methods for rock face characterization", Golden, CO, June 17-18, 2006. American Rock Mechanics Association (ARMA).
2) F. Tonon, W. Wu, X. Liu (eds.), (2010); "Deep and Underground Excavations" ASCE Geotechnical Special Publication 206, Proceedings of the session "Deep excavations & retaining structures, New frontiers in urban geotechnology, Tunneling and underground constructions" at GeoShanghai 2010. American Society of Civil Engineers (ASCE). ISBN: 978-0-7844-1107-0.

10.2 Book chapters

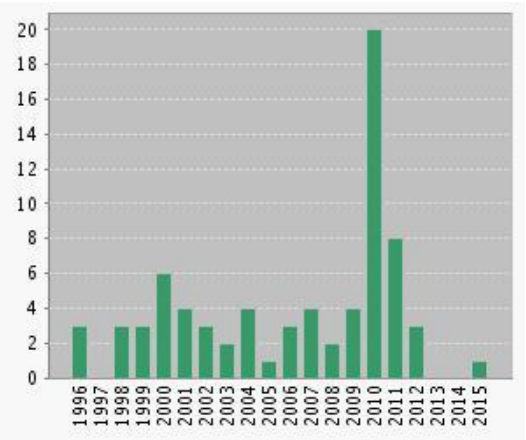
1) F. Tonon, A. Mammino, F. Pagliacci and P. Borghi, Final lining ahead of a tunnel face by means of the Pretunnel system: equipment, case histories, and design procedures. *MIR 2000 – Mechanized Tunneling*, 275-309 (G. Barla ed.). Patron, Bologna, 2000.
2) A. Bernardini and F. Tonon, Bounding Uncertainty in Civil Engineering: Theoretical Background and Applications. *Nondeterministic Mechanics (CISM International Centre for Mechanical Sciences, Courses and Lectures, Vol. 539)*, 227-259 (I. Elishakoff and C. Soize eds.). Springer, 2013. ISBN: 978-3709113059.

10.3 Papers

10.3.1 Refereed journals

ISI Web-of-Science statistics: Current h-index = 15; Citing Articles *without* self-citations: 785; Average Citations per Item: 11.49 (updated Sept. 8, 2017). Scopus statistics: Current h-index = 19; Citing Articles *without* self-citations: 918; Average Citations per Item: 11.49 (updated Sept. 8, 2017).

Published Items in Each Year



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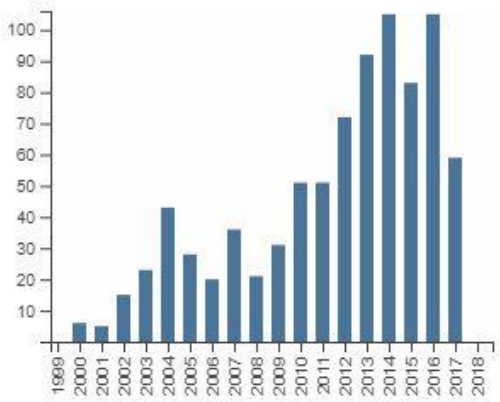

1) F. Tonon and A. Bernardini, A Random Set approach to the optimization of uncertain structures. *Computers and Structures* 68 (1998) 583-600.

2) F. Tonon and A. Bernardini, Multiobjective optimization of uncertain structures through Fuzzy Set and Random Set theory. *Computer-Aided Civil and Infrastructure Engineering* 14 (1999), 119-140.

3) a) F. Tonon, Generalization of Mauldon's and Goodman's vector analysis of keyblock rotations. *ASCE's Journal of Geotechnical and Geoenvironmental Engineering* 124(10) (1998), 913-922. DOI: 10.1061/(ASCE)1090-0241(1998)124:10(913).

   b) F. Tonon, Closure on the discussion of the paper "Generalization of Mauldon's and Goodman's vector analysis of keyblock rotations". *ASCE's Journal of Geotechnical and Geoenvironmental Engineering*, 126(1) (2000), 99.

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45) P. Asadollahi and F. Tonon, Safety factor of a rock block. In Proc. *45th US Rock Mechanics Symposium*, (San Francisco, CA, USA), June 26 – 29, 2011. Paper 11-468. ARMA, Washington, DC, USA.

46) A. E. Gharahbagh, J. Rostami, A.R. Ghasemi and F. Tonon, Review of rock abrasion testing. In Proc. *45th US Rock Mechanics Symposium*, (San Francisco, CA, USA), June 26 – 29, 2011. Paper 11-141. ARMA, Washington, DC, USA.

47) Y. Wang, F. Tonon and R. Guardia, 2D rock-fall simulations taking into account rock fragmentation. In Proc. *45th US Rock Mechanics Symposium*, (San Francisco, CA, USA), June 26 – 29, 2011. Paper 11-167. ARMA, Washington, DC, USA.

48) S. Kim and F. Tonon, Development of simple prism-and-wedge upper bound model for support pressure for undrained tunnel face. In Proc. *North American Tunneling Conference 2012*, Indianapolis, IN, June 24-27, 2012, 255-266. Society for Mining, Metallurgy, and Exploration, Inc., Englewood, CO, USA.

49) X. You and F. Tonon, Decision analysis with Imprecise Probabilities: optimal exploration plan for underground construction. In Proc. *North American Tunneling Conference 2012*, Indianapolis, IN, June 24-27, 2012, 484-492. Society for Mining, Metallurgy, and Exploration, Inc., Englewood, CO, USA.

50) R. Chen and F. Tonon, Rock tunnel groundwater prediction in a simulated rock fracture network In Proc. *North American Tunneling Conference 2012*, Indianapolis, IN, June 24-27, 2012, 401-410. Society for Mining, Metallurgy, and Exploration, Inc., Englewood, CO, USA.

51) F. Tonon, Tunneling in Difficult Conditions – The Squeezing Case – Keynote Lecture. In Proc. *GeoCongress 2012: State of the Art and Practice in Geotechnical Engineering, ASCE Special Geotechnical Publication No. 225* (Oakland, CA, USA), March 25-29, 2012, 380-397. ASCE, Reston, VA, USA.

52) X. You and F. Tonon, Event Tree and Fault Tree analyses in tunneling with Imprecise Probabilities. In Proc. *GeoCongress 2012: State of the Art and Practice in Geotechnical Engineering, ASCE Special Geotechnical Publication No. 225* (Oakland, CA, USA), March 25-29, 2012, 2885-2894. ASCE, Reston, VA, USA.

53) P. Asadollahi and F. Tonon, Anisotropic dilatant behavior of rock fractures. In Proc. *GeoCongress 2012: State of the Art and Practice in Geotechnical Engineering, ASCE Special Geotechnical Publication No. 225* (Oakland, CA, USA), March 25-29, 2012, 3332-3341. ASCE, Reston, VA, USA.

10.3.3 Other articles

1) F. Tonon, Italy-USA Two different schools of engineering. *C.E.A.E. Newsletter* (K. Gerstle, ed.), Spring 1999, pp. 13-14, Department of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder.
2) F. Tonon, Academia-industry partnership: something is moving. Geostrata, ASCE, pages 12 and 16.

10.3.4 Reports

1) F. Tonon, A. Bernardini and A. Mammino, Handling Murphy's and anti-Murphy's laws in Rock Engineering through Random Set Theory : Part I parameters. Part II functions of parameters. Internal Report R.I. 01/97 – June 1997. Department of Structural Mechanics, University of Padua, Italy.
2) B. Amadei and F. Tonon, *In situ* stress measurements at Seminoe Dam. US Bureau of Reclamation Contract 1425-97-CA-81-20003. August 2000.
3) F., Tonon, A.P., Raibagkar, H. Youn. Effect of Verification Cores on Tip Capacity of Drilled Shafts. University of Texas at Austin, Center for Transportation Research (CTR), 2008. (CTR 5825-1)

10.3.5 Guidelines

International Tunneling Association (ITA), Working Group 2: "Guidelines for Tunneling Risk Management". *Tunnelling and Underground Space Technology*, 19, 2004, 217–237. DOI: 10.1016/j.tust.2004.01.001.

11. Rock Mechanics Laboratory

The laboratory is certified ISO 9001:2008 (DNV-GL), and it is authorized by the Italian Ministry for Infrastructures (N. 410 dated 27/11/2015).

ITEM	DESCRIPTION	
1a	Direct Shear Test (ASTM D5607): one intact rock specimen, 1 normal load; peak and residual shear loads, normal and shear displacements.	
1b	Direct Shear Test (ASTM D5607): one specimen containing one fracture, 3 normal loads; peak and residual at each normal load: peak and residual shear loads, normal and shear displacements.	
1c	Direct Shear Test at constant normal stiffness on a specimen containing one fracture in order to obtain the (shear stress)-(shear displacement) law under constant stiffness.	
1d	Determination of normal and shear stiffness of a fracture.	In addition to 1b or 1c
		Independent test
2	Uniaxial Compressive Strength without Static Moduli (ASTM D7012).	
3	Uniaxial Compressive Strength with Static Moduli (ASTM D7012)	
4a	Triaxial Test on Core Specimens Without Pore Pressure Measurements (ASTM D 7012) in Hoek cells (very hard rock and medium-high confinement) or in rapid triaxial cell (medium hard rocks and medium confinement). One Stage, one specimen.	
4b	Triaxial Test on rock core specimens without pore pressure measurements (ASTM D 7012) in triaxial cell with soft membrane (soft rock and/or low confinement). One Stage, one specimen.	
5a	Consolidated/Undrained (CIU or CAU) triaxial test on rock samples with pore pressure measurement (ASTM D 4767) in triaxial cell with soft membrane (soft to medium hard rocks). One Stage, one specimen.	
5b	Multistage Unconsolidated-Undrained Triaxial Test on intact rock or on specimen with a single fracture without pore pressure measurement in triaxial cell with soft membrane in order to determine the entire total stress failure envelope from a single specimen. One specimen.	
5c	Multistage consolidated/undrained (CIU or CAU) triaxial test on rock samples with pore pressure measurement in triaxial cell with soft membrane (medium to hard rocks) in order to determine the entire failure effective stress envelope from a single specimen. One specimen.	
6	Splitting Tensile Strength (Brazilian) (ASTM D3967).	
7	Slake Durability (ASTM D4644).	
8.1	Unit Weight (Bulk Density) of Rock (ISRM Suggested Methods).	
8.2	Porosity of Rock (ISRM Suggested Methods).	
8.3	Specific Gravity of Solids of Rock (ISRM Suggested Methods).	
9	Moisture Content in Rock by Mass (ASTM D2216, Method A or ASTM D4643).	
10	Atterberg Limits (rock: includes rock crushing and grinding) (ASTM D4318).	
6	Splitting Tensile Strength (Brazilian) (ASTM D3967).	
7	Slake Durability (ASTM D4644).	
8.1	Unit Weight (Bulk Density) of Rock (ISRM Suggested Methods).	
8.2	Porosity of Rock (ISRM Suggested Methods).	
8.3	Specific Gravity of Solids of Rock (ISRM Suggested Methods).	
9	Moisture Content in Rock by Mass (ASTM D2216, Method A or ASTM D4643).	
10	Atterberg Limits (rock: includes rock crushing and grinding) (ASTM D4318).	

ITEM	DESCRIPTION	
11	Rebound Hardness - Schmidt Hammer (ASTM D5873).	
12	Cerchar Abrasivity Index (ASTM D7625).	
13	Point Load Test (ASTM D5731).	
	NTNU-SINTEF tests for predicting drill bit consumption or penetration rate and abrasion of rock TBM cutters:	
	14	Sievers J-number Drillability test.
	15	Abrasion Value test or Abrasion Value Cutter Steel test.
	16	Brittleness value S20 test.
17.1	NTNU-SINTEF Soil Abrasion Test (SAT).	
17.2	Slurry Abrasivity (Miller Number) (ASTM G75)	
17.3	Slurry Abrasion Response (SAR) (ASTM G75).	
18.1	Thin Section Petrographic Analysis on competent rock.*	
18.2	Thin Section Petrographic Analysis on non-competent rock (requires impregnation).*	
18.3	Thin Section Petrographic Analysis on soil (requires impregnation).*	
18.4	Determination of Equivalent Quartz Content (in addition to 18.1, 18.2 or 18.3).	
18.5	Determination of Quartz Content in Soil Based on Visual Appraisal	
19	Pulse Velocity & Dynamic Elastic Constants (ASTM D2845).	
20	Mohs hardness tests (Manual of Physical Geology).	
21	Vickers hardness tests, 5 indentations. (ASTM E 384 REV A) *	
22	Shore Scleroscope test, 5 measurements (ASTM D2240) *	
23.1	Axial Swelling Stress Test (ISRM Suggested Methods for Laboratory Testing of Swelling Rocks 1999)	
23.2	Axial and Radial Free Swelling Strain (ISRM Suggested Methods for Laboratory Testing of Swelling Rocks 1999)	
23.3	Axial Swelling Stress as a Function of Axial Swelling Strain (ISRM Suggested Methods for Laboratory Testing of Swelling Rocks 1999)	
24	Huder-Amberg swelling test (Wittke, Rock Mechanics)*	
25.1	Bulk and Detailed Clay (<4 micron) X-ray diffraction (XRD) Analysis* (soil, rock with supplement)	
25.2	X-ray diffraction analysis to identify clay minerals for soil* (soil, rock with supplement)	
25.3	Bulk (Whole-rock) Only X-ray diffraction (XRD) Analysis (soil, rock with supplement)	
26	Supplement for X-ray diffraction analyses on rock (includes grinding)*	
27	SCHIMAZEK Index (Antraquip)	
28	Hydraulic conductivity of intact rock (Matest manual)	
29	Punch penetration test (EMI, Colorado School of Mines)	
30.1	Sieve Analysis (ASTM D6913)	
30.2	Hydrometer Analysis (ASTM D422)	
31	Simplified geologic description (Manual of Physical Geology)	
32	Determination of water absorption (UNI-EN 13755)	
33.1	Determination of Frost Resistance, Test A, Flexural Strength (UNI-EN 12371 and 12372)	
33.2	Determination of Frost Resistance, Test A, Compressive Strength (UNI-EN 12371 and 1926)	
33.3	Determination of Frost Resistance, Test B, Identification (UNI-EN 12371)	
34	Determination of flexural strength (UNI-EN 12372)	
35	Absorption and Bulk Specific Gravity, on 5 cubes (ASTM C97)	
36	Compressive Strength on 5 cubes (ASTM C170)	

ITEM	DESCRIPTION
37	Modulus of Rupture on 3 points, 5 slabs (ASTM C99)
38	Flexural Strength on 4 points, 5 slabs (ASTM 880)
39	Supplement to Items 36-38 for 48 freeze and thaw cycles
40	LCPC Broyability (AFNOR, P18-579)
41	LCPC Abrasiveness (AFNOR, P18-579)
42	Jar Slake Test (P. Santi, 1998)
43	Chert Content in Limestone
44.1	Methylene Blue Index of Clay; on clay supplied by client (ASTM C837)
44.2	Methylene blue adsorption on rock, includes rock pulverization (ASTM C837)
45.1	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus (ASTM D 6928), on aggregate supplied by client
45.2	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus (ASTM D 6928) on rock, includes crushing
46	Mode I Fracture Toughness Using Cracked Chevron Notched Brazilian Disc (CCNBD) Specimens, without displacement measurement (ISRM 1995)
47	Consolidation Test on Rock up to 38,000 kPa (ASTM D2435/D2435M, Method A)
48	Cyclic Triaxial Test on Rock, one specimen, 1,500 cycles (Modified ASTM D5311/D5311M: no consolidation and no pore water pressure measurement). Plots of: deviator stress vs cycles, axial strain vs cycles, stress vs strain, stiffness vs cycles, damping vs cycles.
49	Uniaxial Creep Test with Measurement of Axial Strain (ISRM Suggested methods)
50	Volumetric Thermal Expansion (20°C to 80°C) (Larsson 2001)
51	Identification and Classification of Dispersive Clay Soils by the Pinhole Test (ASTM D4647)

Clients so far include: Fugro (USA, Central America, South America, Europe), Kleinfelder, PB, Kiewit, Hatch Mott MacDonald, Black and Veatch, Holt Engineering, Shannon and Wilson, Lachel and Associates, HVJ, AMEC, URS-AECOM, Coffey Engineering, S&ME, Freese and Nichols, InTEC, BHP Billiton, Coffey Engineering, Poyry, Rakita Exploration doo Bor, Freeport-McMoRan, Erdbau, Geolabor, Rio Tinto, Tecno Piemonte and COCIV, Rio Tinto, Golder Associates, S.G.L. Servizi Geotecnici Liguri Srl, .

Representative projects include: Devil's Slide tunnel (CA), Downtown tunnel (Austin, TX), Rosslyn shaft expansion (DC Metro), Apex tunnel (NV), Silicon Valley Rapid Transit Project (CA), Muni Project (San Francisco, CA), South IH-35 Utility Infrastructure implementation Plan (Austin, TX), Los Angeles Outfall (CA), DWU SW pipeline West (Dallas, TX), Jollyville Tunnel (Austin, TX), Northeast Wastewater 30-Inch Main (Austin, TX), Harris Branch Wastewater Interceptor (Austin, TX), SR 99 Tunnel Project (Seattle, WA), Waller Creek Tunnel (Austin, TX), Panama City Subway Project (Panama), Boggy Creek Water Line Replacement (Austin, TX), SAWS Western Expansion B (San Antonio, TX), White Point Landslide (CA), Delta Habitat Conservation & Conveyance Program (CA), Eglinton Scarborough Crosstown (Toronto, Canada), Dry Comal Creek Flood Retarding Structure (Austin, TX), Mansfield Dam Rehabilitation (Austin, TX), EWS-Coloso Mine (Antofagasta, Chile), Minera Escondida (Chile), Westside Subway Extension (Los Angeles, CA), NorthEast Interceptor Sewer (NEIS) (Los Angeles, CA), Regional Connector (Los Angeles, CA), 64-km long 8.1-m dia. two-tube Brenner Base Tunnel (Italy-Austria), Drumanard Tunnel (IN-KY), Guadalajara subway (Mexico), MSD Deer Creek Tunnel (MO), JWPCP Effluent Outfall Tunnel Project (Los Angeles, CA), Central Bayside Tunnel (San Francisco, CA), New sewer along Isarco river between Cardano and Bolzano (BZ, Italy), Anderson Dam Seismic Retrofit Project (CA), Chukaru Peki mine exploration (Serbia), Hass Underground Wine Cellar (BZ, Italy), Loango Field (Offshore Congo), 2015 Elko Area Expansion Project (NV), Jadar Mine Exploration (Serbia), Saint-Nazaire offshore Wind Farm (France), Courseulles-sur-mer offshore Wind Farm (France), Tunnels for the Third Giovi Crossing (Terzo Valico dei Giovi) high-capacity railway line (Italy), Lealholm Fault study (UK), Gwynt Y Mor offshore Wind Farm (UK), Metro Westside Extension (Los Angeles, CA), Observation tower (Dubai, UAE), Nuclear Power Plant Moorside Site Characterization (UK), Newell Creek Dam (Santa Cruz, CA), Scarborough Subway Extension (Toronto, Canada), Acajutla Liquid natural Gas Facility (El Salvador), RDP Tributaries CSO Tunnel (St. Luis, MS), California High-Speed Rail Palmdale to Burbank (CA), Lower Meramec CSO Tunnel (St. Luis, MS), Hornsby Bend Irrigation System Improvements

(Austin, TX), SAR WWTP Sludge Transfer Line (Austin, TX), McLoughlin Point WWTP (Victoria, British Columbia), EBMUD Mokelumne Tunnel (Bixler, California), Central Bayside System Improvement Project – CBSIP- (San Francisco, CA), 15-116 Mastfundamente Vinschgerbahan (BZ, Italy), Burj 2020 700-metres (2,300 ft) megatall skyscraper (Dubai, UAE), BMT Timok copper and gold Mining Project (Rakita Exploration d.o.o., Serbia), A31 Valdastico Nord Highway Tunnel (VI, Italy), S. Antonio Hydropower Power Plant Cavern Enlargement (BZ, Italy), 1,800-MW Grand Eweng Hep Dam Phase 2 (Cameroon), DS233 Sewage Terminal Pumping Station (Jebel Ali, UAE), 7-km long 9.5-m dia. Scolmatore Bisagno Tunnel (GE, Italy) .

12. Grants and contracts at the University of Texas at Austin

My share of research funds reached $1,680,294; total funds have reached $4,145,306.

Co-Investigators	Title	Sponsor	Grant Total	Tonon's share	Grant Period
-	Analysis of single rock blocks for general failure modes	University of Texas, Austin; Summer Research Assistantship	$22,000	$22,000	6/2006-7/2006
-	Unrestricted gift	American Rock Mechanics Association	$11,180	$11,180	August 2006-August 2009
-	Three-dimensional rock-fall analysis with impact fragmentation and fly-rock modelling	Rio Tinto, Australia	$218,370	$218,370	September 2006-August 2009
Jeff Keaton (PI), Randy Knott, Su Mishra, Peter Lagasse, Mike Rucker and Larry Hansen, Raj Valluvan, Erik Bollaert, Bill Haneberg, Johannes Wibowo, Herbert Einstein	NCHRP Project no. 24-29. Scour at Bridge Foundations on Rock	National Cooperative Highway Research Program (NCHRP)	$750,000	$0	September 2006-August 2009
Robert Gilbert and David Fowler (UT)	Influence of Verification Cores on Point Bearing Capacity of Drilled Shafts	Texas Department of Transportation	$343,237	$343,237	September 2006-August 2008
-	Concrete flow at bottom of drilled shafts	BASF, in-kind contribution	$1,000	$1,000	August 2007
-	Degradation of shales around verification cores	International Association of Foundation Drilling (ADSC) , in-kind contribution	$8,000	$8,000	August 2007
-	Concrete flow into verification cores	McKinney Drilling Co., in-kind contribution	$4,000	$4,000	August 2007
Andrew Wimsatt (PI), Tom Scullion, Stefan Hurlebaus, Dan Zollinger, Soheil Nazarian, Parisa Shokouhi	SHRP 2 R06(G); High-Speed Nondestructive Testing Methods for Mapping Voids, Debonding, Delaminations, Moisture, and Other Defects Behind or Within Tunnel Linings	Strategic Highway Research Program (SHRP2)	$1,650,000	$109,562	September 2009-December 2012

Co-Investigators	Title	Sponsor	Grant Total	Tonon's share	Grant Period
Herbert Einstein (PI), Antonio Bobet (PI), Matthew Mauldon, Conrad Felice, L.R. Sousa, Eric Asa, L. J. Pyrak-Nolte, M. Kuchta, J. Rostami, E. Detournay, E. Labuz	Cavern Design for the Deep Underground Science and Engineering Laboratory (DUSEL)	National Science Foundation	$44,374	$1,800	September 2009-August 31st, 2010
-	International Tunneling Consortium (ITC)	Santa Clara Valley Transportation Authority, JF Shea, Herrenknecht , Concrete Systems Inc, Donovan and Hatem, Gall-Zeidler Consultants, Fugro-Brierley Associates, Maccaferri, Grace.	$340,000	$340,000	September 2007-August 2013
-	Third-Party rock testing for tunneling and open cut projects	William Lettis Associates, Fugro, Kleinfelder, Parsons Brinkerhoff, Kiewit, Hatch Mott McDonald, Black and Veatch, Holt Engineering, Shannon and Wilson, Lachel and Associates, HVJ, Rio Tinto	$642,745	$542,745	March 2007-ongoing
-	Trial on-line tunneling course	Jacobs Associates, CH2MHill and Herrenknecht Tunnelling	$5,400	$5,400	January-July 2009
-	On-line Certificate in Tunneling	Students' fees	105,000	105,000	Sept. 2010-Aug. 2012

13. Teaching

13.1 University of Udine, Italy

- "Geotechnical Engineering": undergraduate first course on geotechnical engineering (Fall 2017).
- "Soil Slope and Rock Slope Stability": graduate course that covers stability of slopes in soil and rock, and the relevant stabilization methods (Fall 2017).

13.2 University of Texas, Austin

- CE 357 "Geotechnical Engineering": undergraduate first course on geotechnical engineering (Fall 2005, Spring 2006, Fall 2007, Spring and Fall 2008, Fall 2009).
- CE 311K "Introduction to Computer Methods": undergraduate first course on numerical methods and programming (Spring 2007, Fall 2008, Spring 2010, Fall 2010).
- CE397 "Rock Engineering": graduate course on rock mechanics as it applies to civil engineering applications (Fall 2006, Spring 2008, Fall 2009, Spring 2011). This course had not been offered at UT for over a decade.
- CE 397 "Geotechnical Seminar": graduate seminar on tunneling with 13 invited speakers from the US and overseas (Spring 2007).
- CE 397 "Design and Construction of Tunnels": graduate course that starts from the understanding of the three-dimensional behavior of a tunnel and the importance of the ground ahead of the tunnel face as a stabilization measure. Characterization of tunnel behaviors A, B, and C and their stabilization systems including pre-confinement (precut, pretunnel, fiberglass reinforcement, umbrellas of: jet-grouting, permeation grouting, micropiles and drains) and confinement (radial bolts and dowels, shotcrete, steel sets, one pass and two pass segmental lining, cast-in-place lining and invert, shield with face pressure control). Excavation methods: hard rock Tunnel Boring Machines and blasting, soft ground shield tunneling with Earth Pressure Balance Machines and Slurry Shields and their face support. Numerical and analytical methods for continuum and discontinuum (Spring 2009, Fall 2010).
- On-line Certificate in Tunneling. Addressed to UT grad students, and engineers or engineering geologists who want to obtain a working knowledge of tunnel design or construction management. Conceived of the idea, developed curriculum and over 150 hours of recorded teaching, found and coordinated about 50 invited speakers that add about 150 hours of industry experience and case histories. The program has been endorsed by the International Tunneling Association (ITA); first program outside of Europe and first on-line program to receive the ITA endorsement. (Fall 2010, first cycle). http://lifelong.engr.utexas.edu/certificate.cfm

13.2.1 Supervised Ph.D. students

13.2.1.1 Graduated Ph.D. students

1) Heejung Youn (Fall 2008): "Effect of Verification Core Hole on the Point Bearing Capacity of Drilled Shafts".
2) Yuannian Wang (Summer 2009): "Three-dimensional Rock-fall Analysis with Impact Fragmentation and Fly-rock Modeling".
3) Pooyan Asadollahi (Summer 2009): "Stability Analysis of a Single Three Dimensional Rock Block: Effect of Dilatancy and High-velocity Water Jet Impact".
4) Ran Chen (Summer 2010): "Prediction of Groundwater Inflow in Rock Tunnels by Simulating Fracture Clusters".
5) Sang Yeon Seo (Summer 2010): "Macro-synthetic fibers and glass-synthetic fiber blends as Reinforcement of Precast Segmental Liners".
6) Xiaomin You (Summer 2010): "Risk Analysis in Tunneling with Imprecise Probabilities".
7) Seung-Han Kim (Summer 2010): "Face Stability in Soft-ground Mechanized Tunneling".

8) Xin Xian (co-advised) (Spring 2010). "Application of Neural Networks to the Prediction of Fragmentation During Rock Fall". Faculty of Engineering. China University of Geosciences (Wuhan).
9) Mahdi Heidari (Summer 2013): "Time-dependent Analysis of Jet-grouted Tunnels in Difficult Ground Conditions".

13.2.2 Supervised MS candidates

13.2.2.1 Graduated MS students

1) Sang Yeon Seo (Spring 2008)
2) Anay Raibagkar (Summer 2008)
3) Edmanuel Carrasco (Fall 2010)
4) Moo Yeon Kim (Fall 2011)
5) Singh Vasudev (Spring 2008). Co-advised with Dr. Mukul M. Sharma, Dept. of Petroleum and Geosystems Engineering, University of Texas of Austin.
6) Simone Addotto (Spring 2009). Co-advised with Dr. Daniele Peila, Dept. of. Geoengineering Turin Polytechnic, Italy.
7) Marco Invernizzi (Spring 2009). Co-advised with Dr. Daniele Peila, Dept. of. Geoengineering Turin Polytechnic, Italy.
8) Moo Yeon Kim (Fall 2011)
9) Chris Guy (Fall 2011)
10) Iraklis Koutrouvelis (Spring 2012)
11) Mehran Hosseini Seyed (Spring 2012). Co-advised with Dr. Jon E. Olson, Dept. of Petroleum and Geosystems Engineering.

13.2.3 Graduate committees

13.2.3.1 Ph.D. students

Geotechnical Group (CAEE): Choi, Won Kyoung; Songcheng, Li; Jeon, Seong Yeol; Freilich, Brian Jeremy.
Structural Group (CAEE): Kang, Jun Won; Thammarak, Punchet.

13.2.3.2 MS students

Geotechnical Group (CAEE): Carlos Guzman.

13.3 University of Utah

13.3.1 New courses

- GEO 5150 "Geological Engineering Design", new capstone design course for the Geological Engineering major. Senior undergraduate-beginning graduate level.
- Geotechincal week for GEO 4550 "Field Geology for GE majors". Junior-senior undergraduate level.
- GEO 3075-5075 "Introduction to Geological Engineering", new introductory course to the GE major (undergraduate). The course is also offered at the beginning-graduate level.
- GEO 6920-7920 "Discontinua Engineering" (special topic course) that attracted graduate students from geophysics and civil engineering, as well as professional engineers and engineering geologists. Graduate-advanced graduate level.

13.3.2 Innovations

- Design studio setting for GEO 5150 to bridge the students to a professional environment, in which their projects (reports and drawings) undergo systematic reviews to arrive at the final release.
- Oral exams for GEO 5150 and 6920-7920 designed to measure not only the students subject matter retention, but also overall engineering maturity and breadth (GEO 5150), and their skills at chalkboard exposition and verbal exchange.
- Site visits to construction sites as an integral part of the students' learning experience. Sites visited: Diamond Fork tunnel, UT (twice); Kennecott mine, UT.

- Clar compass to measure discontinuity orientation in one operation: students' learning curve was much shorter than with the Brunton compass, and productivity much higher.

13.3.3 Supervision of graduate students

13.3.3.1 Post MS students preparing to take Ph.D. qualifying exam

Chen, Song (eventually opted for an ME degree).

13.3.3.2 Graduate committees

- Farnsworth, Clifton B.: Ph.D. in geotechnical engineering, Dept. of Civil Engineering, University of Utah, advisor Dr. Steve Bartlett.
- Abdullah, Ozer T.: Ph.D. in geotechnical engineering, Dept. of Civil Engineering, University of Utah, advisor Dr. Evert Lawton.
- LaMeres, Bruce J.: M.S. in geotechnical engineering, Dept. of Civil Engineering, University of Utah, advisor Dr. Evert Lawton.
- Puri, Saurabh: M.S. in mining engineering, Dept. of Mining Engineering, University of Utah, advisor Dr. William G. Pariseau.

13.4 Teaching awards

Nominated for the 2003-2004 departmental teaching award.

13.5 Teaching workshops

- ASCE EXCEED workshop, summer 2006, West Point Academy;
- ASEE mini-course in teaching excellence for science and engineering faculty, "Fresh Perspectives on Teaching", the American Society for Engineering Education at the University of Utah

13.6 Seminars

13.6.1 Departmental seminars

Dept. of Geology and Geophysics, University of Utah, Distinguished Lecture Series: "The new ISRM suggested methods for rock stress measurement", February 26, 2004.

13.6.2 Invited seminars (presentation 6 and following given while at the University of Texas)

1) *A Fuzzy/Random Set Approach to the Multiobjective Optimization of Uncertain Mechanical Systems.* University of Padua, Dept. of Structural Mechanics: "Multicriterion optimization of uncertain systems and structures", Padua, Italy, June 21, 1995.
2) *Multiobjective Optimization of Uncertain Structures: a Fuzzy Set Approach with Application to the Design of Tunnel Lining in Hard Rock.* University of Padua, Dept. of Structural Mechanics: "A Fuzzy Seminar", Padua, Italy, October 2, 1995.
3) *Some Applications of Random and Fuzzy Set Theories to Tunneling*; GEODATA, Turin, Italy, June 20, 1996.
4) *Green's Functions and BEM Formulation in 3-D Generally Anisotropic Solids*. Technical University of Graz, Austria, June 22, 1998.
5) *Final Lining ahead of a Tunnel Face by Means of the Pretunnel System: Equipment, Case Histories, and Design Procedures*. MIR 2000 – Mechanized Tunneling'. On request of Prof. G. Barla, Dept. of Civil Engineering, Turin Polytechnic, Italy, December 5-6, 2000.
6) *Using Random Set Theory to solve Challenge Problem B as proposed by the Epistemic Uncertainty Project*. Sandia National Laboratories: "Epistemic Uncertainty Workshop", August 6-7, 2002, Albuquerque, New Mexico.
7) *Rock Mass Classifications and Some New Q-value Correlations for Site Characterization*. Utah branch of the Association of Engineering Geologists, Salt Lake City, UT, January 9, 2003.

8) *Toward a Definition and Understanding of Correlation for Variables Constrained by Random Relations*. University of Bristol, Dept. of Civil Engineering: "Uncertainty and Decision-making in Civil Engineering", Bristol, UK, July 22-23, 2004.
9) *A Search Algorithm for Calculating Validated Reliability Bounds*. Georgia Institute of Technology, Dept. of Civil Engineering, and NSF: "Reliable Engineering Computing", September 14-17, 2004. Savannah, Georgia.
10) *Multiobjective Optimization of Tunnel Linings with Case Histories*. Jacobs Associates, San Francisco, CA, Dec. 2, 2005.
11) *Using Extended Interval Algebra in Discrete Mechanics*. Georgia Institute of Technology, Dept. of Civil Engineering, and NSF: "Reliable Engineering Computing 2006: Modeling Errors and Uncertainty in Engineering Computations", February 22-24, 2006. Savannah, Georgia.
12) *State-of-the-Art Technology for Large Diameter Transportation Tunnels*. Transportation Research Board Meeting. Washington DC. January 15th, 2008.
13) *From the ADECO-RS Approach to Tunneling Industrialization*. Transportation Research Board Meeting. Washington DC. January 15th, 2008.
14) *A defunct Project for a Single Tube Subway in Seattle*. Transportation Research Board Meeting. Washington DC. January 15th, 2008.
15) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. URS; Oakland, CA, September 16, 2008.
16) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Caltrans; Sacramento, CA, September 17, 2008.
17) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Obayashi; South San Francisco, CA, September 18, 2008.
18) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. AECOM, URS Joint Venture for Silver Line Phase 4; Boston, MA, October 27, 2008.
19) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. AECOM; New York, NY, January 26, 2009.
20) *ADECO as an Alternative to NATM: How it Works, Why it Works*. Rapid Excavation and Tunneling Conference (RETC), Las Vegas, NV, June 14-17, 2009.
21) *A Historical Excursus on Sequential Excavation, NATM and ADECO*. RockSoil 30th Anniversary Symposium, Milan, Italy, October 16, 2010.
22) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Balfour Beatty; London, UK, May 25, 2010.
23) *Ground Freezing with Case Histories*. Cross-Rail; London, UK, May 26, 2010.
24) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Shandong Transportation Institute, Jinan, PRC, June 7 2010.
25) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Changsha University of Science and Technology, Changsha, PRC, June 8 2010.
26) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Tongji University, Shanghai, PRC, June 11 2010.
27) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Beijing Jiaotong University, Beijing, PRC, June 12 2010.
28) *Design of Tunnel Support*. Training course of the International Tunneling and Underground Space Association. Helsinki, Finland, May 20-21, 2011.
29) *ADECO: Engineering the Tunnel Core for Underground Excavation in Difficult Ground*. Hohai University, Nanjing, PRC, June 14 2011.
30) *Bounding Uncertainty in Civil Engineering: Motivation and Basic Concepts*. Tutorial at ISIPTA '11 - Seventh International Symposium on Imprecise Probabilities: theories and applications. Innsbruck, Austria, July 27, 2011.

14. Professional service

14.1 University of Texas, Austin

14.1.1 Service to the University Texas, Austin

Department Committees:

- Distinguished Lecture Series, Member: 2005-2009. Invited speakers: Dr. R.E. Goodman (4/2006); Dr. W. F. Brumund (10/2006); Dr. E. Cording (4/2008); Dr. P. Marinos (1/2010).
- CE & ARE Curriculum, Member: 2006-2007.
- Undergrad Recruiting & Retention, Member: 2005- present.

14.1.2 Service to the profession and the public

14.1.2.1 Workshops and Short Courses Organized

- Laser and Photogrammetric Methods for Rock Face Characterization. Sponsors: US Bureau of Reclamation, Federal Highway Administration, and Split Engineering; amount $ 16,000. In conjunction with GoldenRocks 2006, 41st U.S. Rock Mechanics Symposium, Colorado School of Mines, Golden, CO, June 17 - 18, 2006. 40 participants from four continents.
- Laser and Photogrammetric Methods for Rock Tunnel Characterization. In conjunction with 42nd U.S. Rock Mechanics Symposium, San Francisco, CA, June 28 - 29, 2008.
- Introduction to Tunneling; 4-hour course developed from scratch and delivered. In conjunction with GeoCongress 2012: State of the Art and Practice in Geotechnical Engineering (Oakland, CA, USA), March 25, 2012.

14.1.2.2 Paper review activity

Member of editorial board for:

1) Int. Journal of Reliability and Safety, editor in chief Zissimos P. Mourelatos (Inderscience Publisher).
2) Engineering Geology, editor in chief Gian Battista Crosta (Elsevier).

Reviewer for the following journals:

- ASCE Journal of Geotechnical and Geoenvironmental Engineering.
- Rock Mechanics and Rock Engineering.
- International Journal for Numerical and Analytical Methods in Geomechanics.
- Engineering Geology.
- Mathematical Geology.
- Reliability Engineering & System Safety.
- American Institute of Aeronautics and Astronautics (AIAA).
- ZAMM: Journal of Applied Mathematics and Mechanics, Zeitschrift für Angewandte Mathematik und Mechanik.
- Information Sciences.
- Computer-Aided Civil and Infrastructure Engineering.

Reviewer for the following Agencies:

- The National Science Foundation.
- The U.S. Civilian Research & Development Foundation (CRDF).
- TRB Committee AFS20, Soils and Rock Instrumentation.
- TRB Committee AFP30, Soils and Rock Properties.

- TRB Committee AFF60, Tunnels and Underground Structures.

14.2 University of Utah

14.2.1 Service to the University of Utah

Department Committees:

- Geological Engineering (GE): member 2002-2005; interim chair (7/2003-12/2003).
- Undergraduate Internship: 2002-2005.
- Undergraduate Affairs: 2004-2005.

Student advisor:

Advisor of the University of Utah student chapter of Engineers Without Borders – USA (EWB-USA): a non-profit organization established to help developing areas worldwide with their engineering needs, while involving and training a new kind of internationally responsible engineering student.

2002: Proposed to redesign and drafted new undergraduate curriculum for the GE program in order to remove ABET deficiency on curriculum identified in 1997, 2000, and January 2002 visits (Criterion I.C.3.a.(3)); the deficiency was removed in 2003 visit, when the GE program was re-accredited. Removed ABET deficiency on major design experience (Criterion I.C.3.d.(3)) identified in 1997, 2000, and January 2002 visits by developing GEO 5150 from scratch. These two deficiencies led to non-accreditation of the GE program in the January 2002 visit, but were identified by the undersigned before joining the University of Utah in February 2002. Developed new website for the GE program, developed ties with the Department of Civil Engineering of the University of Utah, organized 2 site visits to construction sites for GE students.

2003: Introduced John F Wallace, P.E. and principal of IGES, as a new member of the GE constituency, finalized ABET self-study for re-accreditation, served as interim chair of the GE committee during Dr. W. Johnson's leave, coordinated ABET visit for re-accreditation, collected coursework material and conducted GE course assessment for ABET (Spring 2003 semester) with Dr. W. Johnson, organized 1 site visit to a construction site for GE students.

2004: Collected coursework material and conducted GE course assessment (Fall 03 semester) for ABET, prepared GE brochure, saved $1,000 by printing 1,000 GE brochures "in house", distributed GE brochures at the Union, and Calculus I and II, posted GE brochures around campus, participated in 3/27/04 incoming freshmen orientation, prepared recruiting letter to incoming engineering students (with Dr. P. Jewell), prepared GE presentation and booth at 2004 Engineering Day. Passed the Fundamental of Engineering (FE) exam required of GE majors for obtaining graduation (spring 2004).

14.2.2 Service to the profession and the public

14.2.2.1 Conference sessions organized and chaired

- "Generalized models of uncertainty for engineering mechanics". Attracted 7 papers. *9th ASCE Joint Specialty Conf. on Probabilistic Mechanics and Structural Reliability, PMC04* (Wojtkiewicz, S., Ghanem, R. and Red-Horse, J., eds.), Albuquerque, NM, July 26-28, 2004. (With M. Beer and C. Pettit.)
- "Engineering with Blocky Rock Masses" and "Laser Scanning and Photogrammetric Techniques". 41st US Rock Mechanics Symposium. Golden, CO, June 17-21, 2006.
- "Large Tunnels for Transportation Projects". Transportation Research Board Meeting, Washington DC, January 15th, 2008.
- "Deep excavations & retaining structures, New frontiers in urban geotechnology, Tunneling and underground constructions", Geoshanghai 2010, Shanghai, PRC, June 3rd-5th, 2010.
- 2012 ASCE Geocongress, Oakland, CA, March 25-29, 2012:
  - Characterization and design in rock mechanics
  - Design and construction of rock tunnels
  - Analytical and numerical methods in discontinuous media

- Uncertainty and risk analysis is rock engineering applications
- Characterization, treatment, and rehabilitation of dam foundations in rock

- 2013 ASCE Geocongress, San Diego, CA, March 3-6, 2013:
  - Design and Analysis of Rock Slopes.
  - Characterization of Soil and Rock.

14.2.2.2 Conference sessions chaired

1) Session 4.6 "Tunneling projects". *Soil and Rock America 2003 - 12th Panamerican Conference on Soil Mechanics and Geotechnical Engineering and 38th US Rock Mechanics Symposium*, Cambridge, Massachusetts, June 22-25, 2003.
2) "Numerical Modeling of Discontinuous Rock Masses" GeoFlorida 2010, Palm Beach, FL, February 20-24, 2010.
3) "Tunneling II" *45th US Rock Mechanics Symposium*, (San Francisco, CA, USA), June 26 – 29, 2011.

15. Other activities

(11)1996-(10)1997 Civil Service in Italy.

1999-present: Translation from Italian into English of grant proposals addressed to the European Community for the Architecture and Civil Engineering Departments of the Universities of Ancona and Venice, Italy, and of technical papers for Parsons Brinckerhoff (USA).

Fulvio Tonon, P.E, Ph.D. January 19, 2018