Special Seminar on

Effective Use of Tunnelling and Underground Space for Sustainable Development

25th March 2017 (Saturday)

9:00 am – 4:30 pm

Yangon Technological University
Gyogone, Yangon, Myanmar

Organized by

Myanmar Tunnelling and Underground Space Committee (MTUSC)

Myanmar Engineering Society (MES), Myanmar Geoscience Society (MGS)

International Tunnelling and Underground Space Association (ITA)

Myanmar Tunnelling and Underground Space Committee (MTUSC) of the Myanmar Engineering Society is honoured to announce that ITA Executive Council led by the President Professor Tarcisio B. Celestino has accepted to hold the Executive Council Meeting in Yangon on 26 and 27 March 2017**,** which will be the first time for such a meeting to be held in Yangon.

On the occasion of ITA Executive Council Meeting in Yangon, MTUSC is organising one-day Special Seminar on **"Effective Use of Tunnelling and Underground Space for Sustainable Development"** on 25 March 2017**.** Ten technical lectures will be delivered by the Executive Council Members and specially invited speakers, world-renowned specialists in tunneling and underground space industry.

International Tunnelling and Underground Space Association (ITA-AITES or ITA) is an international technical-based organization having Special Consultative Status with United Nations since 1987. ITA is actively working in cooperation with United Nations International Strategic Disaster Reduction (UN-ISDR) and UN Habitat. Founded in 1974 by nineteen nations, ITA now consists of 73 Member Nations and over 300 Corporate or Individual Affiliate Members. Cambodia, Indonesia, Laos, Malaysia, Myanmar, Singapore, Thailand and Vietnam are ITA Member Nations in Southeast Asia. Bhutan, China, India, Japan, South Korea and Nepal are also Member Nations of ITA. Myanmar Tunnelling and Underground Space Committee (MTUSC) became a Member Nation in 2012 during ITA General Assembly in Bangkok, Thailand.

The key missions of ITA are ;

- to encourage the use of the subsurface for the benefit of public, environment, health, safety, and sustainable development
- to promote advances in planning, design, construction, maintenance and safety of tunnels and underground space

ITA is committed to contributing to both urban and rural sustainable development and resilience to climate change by showing how underground space can play a crucial role in these issues.

Myanmar is in need of various infrastructures for urban and rural transportation, water supply and power generation which involve different forms of tunneling and underground excavation works.

Lectures on topics related to the theme of the seminar **"Effective Use of Tunnelling and Underground Space for Sustainable Development"** will be delivered by world-class experts in their respected fields. It is an excellent opportunity for professionals in Myanmar construction and related industries to participate in the seminar to learn practical aspects of tunnelling and underground space utilization lectured by prominent lecturers.

Myanmar Tunnelling and Underground Space Committee (MTUSC), under the umbrella of the Myanmar Engineering Society, has been playing a pivotal role in promoting tunnelling and underground construction works in Myanmar. MTUSC serves as an important link between the local and the global tunnelling and underground space societies.

The seminar will serve as a platform where participants will be able to exchange ideas with experts from different countries on the importance and benefits of Tunnelling and Underground Space for sustainable development in Myanmar. Besides being involved in an excellent technical discussion, exchanging ideas and sharing experience, participants will have the opportunity to meet with high-level industry leaders.

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PROGRAMME

08:30	–	09:00 am	**Registration**
09.15	–	09.30 am	**Welcome Speech by Organizing Chairman** **Introductory Speech by Professor Tarcisio B. Celestino, President, International Tunnelling and Underground Space Association (ITA)**
			Tunnels and Underground Space in Hydropower Projects
09.30	–	10:00 am	**Optimization Underground Power House Design: Example of Paulo Afonso IV, Brazil** **Professor Tarcisio B. Celestino,** PhD, President, International Tunnelling and Underground Space Association (ITA)
10:00	–	10.30 am	Experiences in Tunnelling in Hydropower Projects in Thailand and Neighbouring Countries, **Dr. Noppadol Phienwej , Past President of Thailand Underground and Tunnelling Group, Thailand Geotechnical Society, Engineering Institute of Thailand**
10.30	–	11.00 am	**Design and Construction of Large Caverns and Tunnels for the Ulu Jelai Hydroelectric Project, Malaysia** **Alexandre GOMES**, Vice President, International Tunnelling and Underground Space Association (ITA)
11.00	**–**	**11.15 am**	**Coffee break**

			Effective Use of Tunnelling and Underground Space in Urban area
11.15	–	11.45 am	**Why go Underground – Benefits in the Use of the Underground Spac**e **Mr. Søren Degn.** Eskesen, Past President, International Tunnelling and Underground Space Association (ITA)
11.45	–	12.15 pm	**Tunnelling Induced Ground Settlement** **Mr. Eric Leca**, Vice President, International Tunnelling and Underground Space Association (ITA)
12.15	–	1.30 pm	**Lunch**
1.30	–	2.00 pm	**Urban and Geotechncical Constraints for Metro Stations** **Professor Tarcisio B. Celestino,** PhD, President, International Tunnelling and Underground Space Association (ITA)
			Road and Rail Tunnels
2.00	–	2.30 pm	**Design and Construction of Long Railway Tunnels in China** **Professor Jinxiu Yan,** Vice President International Tunnelling and Underground Space Association(ITA)
2.30	–	3.00 pm	**New Railway Line Divaca – Koper, Slovenia** **Dr. Davorin Kolić**, Member of the Executive Council, International Tunnelling and Underground Space Association (ITA)
3.00	–	3.30 pm	**Coffee Break**
3.30	–	4.00 pm	**Modern Drilling and Blasting Pattern Design for Underground Rock Excavation** **Pekka Nieminen,** Member of the Executive Council, International Tunnelling and Underground Space Association (ITA)
4.00	–	4.30 pm	**Construction of Two tunnels in Difficult Stress-strain Conditions : Results of Real Comparison between NATM and ADECORS** **Giuseppe LUNARDI,** Member of the Executive Council, International Tunnelling and Underground Space Association (ITA)

Synopsis

Optimization Underground Power House Design: Example of Paulo Afonso IV, Brazil, **Professor Tarcísio Celestino, PhD.**

The use of final lining sprayed concrete will be shown associated to the advantages in comparison to conventional cast in situ concrete. The example of the Paulo Afonso IV underground power station with 26-m span will be taken. A conventional design with an up to 1.8 m thick reinforced concrete arch was developed. This design proved to be unfeasible during construction. Even though the structural analysis of the conditions after construction met all the long-term safety requirements, stability conditions during excavation proved to be critical and the design had to be abandoned. Sprayed concrete was adopted in combination with rock bolts. The thickness of the sprayed concrete is only 0.15 m and the exaction span was reduced from 32.6 to 26.0 m. The advantages of the new design with respect to cost and construction time were very significant. The reduction of construction time allowed the anticipation of commissioning and operation of the power house, bringing also anticipated revenues and benefits. Results of predicted and measured displacements during construction will be shown. A risk analysis was carried out and the results of structural reliability considering failure modes of potential block instability is presented. Long term reliability requirements were also met with the new design. Other examples of the use of sprayed concrete for final lining of transportation infrastructure underground works will be presented along with cost savings in comparison to conventional solutions.

Experiences in Tunnelling in Hydropower Projects in Thailand and Neighbouring Countries, Dr. Noppadol Phienwej , Past President of Thailand Underground and Tunnelling Group, Thailand Geotechnical Society

The talk will brief the experiences of the authors from involvement in tunnels and cavern design and construction in a couple of major hydropower and projects in Thailand and neighboring countries, particularly Lao PDR. The projects include the Lam Ta Khong Pumped Storage Hydropower Project in Thailand which is the largest underground powerhouse project in the country where the works were constructed in weak sedimentary rocks, the Nam Ngum2 HPP in Lao PDR where large diversion tunnels and power tunnels needed to be constructed in complicated geologic settings under a rush schedule, etc. Geological and geotechnical aspects in the design and construction of the underground works in the projects are outlined with emphasis on highlights and important issues learnt from implementation of the works. Experiences from underground construction works in other hydropower projects of significant values are also to be presented and discussed.

Design and Construction of Large Caverns and Tunnels for the Ulu Jelai Hydroelectric Project, Malaysia, **Alexandre Gomes**

The 372 MW Ulu Jelai Hydroelectric Project is a peaking power scheme located in the Cameron Highlands, Malaysia. The main features of the project include an 84 m high roller compacted concrete dam; two weirs which divert flows from adjacent catchments via transfer tunnels into the main reservoir; an underground power waterway; and an underground power station complex comprising three large caverns with connecting tunnels approximately 240 m below surface level.

The project includes approximately 25 km of tunnels excavated in fresh granite rock mass with some distinct shear zones of weaker material. The majority of the tunnels are being excavated using drill and blast, with the two transfer tunnels being excavated with a tunnel boring machine (TBM).

Why go Underground – Benefits in the Use of the Underground Space, **Søren Degn. Eskesen**

The lecture will focus to answer the main reasons why underground space is important following up an enormous demand for underground structures due to the Environmental Era. Nowadays, underground structures are one of the best solutions for urban problems and for interurban links in mountainous landscape. As regards cities, a wide range of underground structures have been used to improve living conditions. Tunnels for transportation (motorways, metros) and for public utilities (water supply, sewerage, electrical and telephone cables) are a priority in developing countries, and underground structures for city centre revitalisation and for public use (libraries, museums, car parking, entertainment and leisure facilities) are of great interest in developed countries. However, whatever the type of underground structures in an urban environment, they all aim to free surface space for more noble human needs, improving the living conditions of our cities. In the case of interurban links, long-length tunnels are justified by saving time and reducing costs (shorter journeys and less energy consumption), maximizing safety and minimizing environmental impacts. However, one of the most difficult aspects of implementing underground structures is to convince urban designers, politicians, decision makers about their needs and benefits. why go underground ? is one of the ITA's responses to meet this challenge. The ITA has acquired knowledge on this issue and is now releasing the information it has gathered. It is our goal that why go underground ? helps close the gaps between our tunnelling community and those who decide the priorities of our societies. We are hopeful that why go underground ? will be an important ITA contribution towards a better use of underground space and sustainable development of our world.

Tunneling Induced Ground Settlements, Eric Leca, PhD

The development of cities requires the construction of new infrastructure for transportation as well as utilities. Because many of these structures have to be inserted in an already built environment, tunneling often appears to be an appropriate solution. Many of these tunnels have to be built in difficult conditions, including soft water-bearing soils at shallow depth, underneath existing buildings and other structures.

Although modern technology allows tunneling to proceed in such situations, special care must be exercised to the potential impact of the works on existing structures. After describing the phenomena involved in the construction of shallow tunnels in soft ground, the presentation will address the approaches developed for evaluating the settlements induced at ground surface by construction, as well as mitigation techniques used for limiting the potential impact on aboveground and shallow existing structures. Case histories from the construction of underground metro projects will be presented to illustrate these phenomena and the approaches developed for controlling ground motion in urban tunneling.

Urban and Geotechncical Constraints for Metro Stations
Professor Tarcisio B. Celestino,

The most usual types of underground metro stations will be presented in connection with urban constraints, geotechnical and groundwater conditions. Whereas the most usual type of construction involves an open excavation, this method has lost applicability due to urban disruption caused during construction. The use of struts for wall support can become a problem during construction for the movement of equipment and materials. Tiebacks can solve this problem, but their interference with adjacent structures and water infiltration can bring other type of problems. The so-called inverted excavation method can decrease the length of the period along which traffic restrictions at the surface must be enforced, but even so, quantification of social and economic losses have shown unacceptable results in many cases. In the inverted excavation method, a slab is first constructed at grade and then most of the excavation takes place underneath the slab after traffic at the surface has been restored. These difficulties have favored more and more the use of mined stations. Platform and access tunnels can be excavated from a central or a lateral shaft, depending on the availability of space at the surface. A combination of open and underground excavations can be a good solution when some space is available. The use of secant large-diameter shafts has been used with advantages in substitution to rectangular walls. The arched shape is structurally efficient, saving materials and construction time. Tiebacks and all associated problems are eliminated. The favorable stability conditions during excavation in combination with the favorable structural shape lead to small displacements and negligible damage to adjacent buildings and utility lines. The use of sprayed concrete for support has brought many advantages related to structural and construction logistics. The eventual need for pre-support with slurry walls of jet grouting will be discussed as a function of ground mass quality, permeability and groundwater conditions. Real examples of all types of stations and the need for pre-support will be presented.

Design and Construction of Long Railway Tunnels in China, Professor Jinxiu Yan,

China is a country with a huge number of tunnels, in particular its number of railway tunnels. Up to the end of 2015, there are 13 411 existing railway tunnels with a length 13 083km under operation, 3 784 railway tunnels with 8692km in length under construction and 4 384 railway tunnels with 9 345km in length under design or planning. Among the railway tunnels, many of them are long tunnels. The longest railway tunnel under operation is New Guanjiao Tunnel, 32km long and the 34km long Gaoligongshan Tunnel is the longest one under construction with many challenges. During the design and construction of long railway tunnels,1)two single tubes are usually adopted for tunnels longer than 15km to facilitate construction and disaster prevention and rescue during operation.2)D&B method is mainly used although TBM has been used for some long railway tunnels in mountainous area and shield machine for tunnels in urban area or under water.3) Long tunnel is usually divided into short sections for excavation by using of auxiliary adits for access.4) Geology prediction during tunneling is used to ensure safety of construction.5) For the tunnels longer than 20km, rescue station is set up in the central area of tunnel. This presentation will introduce general situation, design principle, construction methods and disaster prevention and rescue consideration of design and construction of long railway tunnels in China.

New Railway Line Divaca – Koper, Slovenia, **Davorin Kolić, PhD**

The main design of the new railway line Divaca - Koper is finished and reached the finalization level of issued construction permission. Altogether 27 km of the second single track consists of 20 km tunnels and 2 viaducts, passing through limestone and breccia formations and expecting karstic phenomena on the route. Main design has been finished as conventional tunnelling but it is expected that the client open TBM options as well that could seriously shorten the time of construction. Financing has been estimated as private financing with the support of EU funds for rail infrastructure and this type of financing project development is nowadays one of 15 projects in the world that are privately financed in rail infrastructure. Construction time is estimated wit the period of 5-7 years but could be reduced to 4 years only with using new technologies and tunnelling methods. The entire tunneling sections have been designed as conventionally driven tunnels in formations of limestone. Typical cross section has been following requirements of the EU design guidelines for rail underground tunnels and recent practice in rail tunneling. Beside regular requirements for traffic rail tunnels additional profiles and structures have been designed following the concept of safety and ventilation on the rail line like cross over chamber in tunnel T2, additional service tunnel parallel with tubes of T1, T2 andT8 and side tunnels as escape routes with emergency exists. All mentioned structures are planned to be constructed as conventionally driven tunnels with primary support and final reinforced concrete lining but recently TBM options are included in final investigations.

The construction of two tunnels in difficult stress-strain conditions: the results of the real comparison between NATM and ADECORS, **Giuseppe LUNARDI**

The XXII Olympic Winter Games took place in February 2014 in Sochi (Russia). The Russian Federation made a series of major investments in the city in order to fill the lack of infrastructures and to give the necessary access to the ski areas and the Olympic Village in Adler. The new Sochi Bypass is one of these new infrastructures and will consist of eight twin-tube tunnels for a total length of 16 kilometres. For these important works the Russian Federation took the opportunity to test the best and most innovative technologies existing at the international level for underground excavation. For the similarity of the geology in Sochi with the one of the Italian Apennines the Russian government opted to apply the ADECO-RS approach to bore the longest and most complex tunnel of the Sochi Bypass, with the consultancy of ROCKSOIL S.p.A. for the tunnel design. However, the other tunnels along the by-pass, all in similar geological conditions, are driven using NATM, as usual in Russia. Construction works have already begun and all tunnels are progressing in parallel, it is therefore the first real direct comparison, under quite similar difficult conditions, between NATM and ADECO-RS. The experiences gained in the excavation of the Sochi tunnels by using NATM or ADECO-RS are reported and compared in the paper.

Modern Drilling and Blasting in Tunneling and Underground Space Excavation**, Pekka A. Nieminen,**

The modern underground Drill and Blast (D&B) design starts by defining the tunnel line and tunnel profile with tolerances. The performance and quality of the excavation is largely impacted by drilling accuracy. Inaccurate drilling causes poor advance and over- and underbreak, but the same phenomena can also be caused by blasting, if not properly designed and executed. In the modern D&B cycle blast holes as well as bolting and especially grouting holes are recorded with drilling data for analyses. The drilling and blasting design can be developed and optimized by comparing the drilling and blasting data to excavation quality, round advance and blasting vibration measurements. With well-designed and executed D&B different profile designs and shapes of underground space can be implemented in various rock conditions safely.

Speakers Profile

Professor Tarcísio Celestino, PhD.
President, International Tunnelling and Underground Space Association

Professor Tarcísio Celestino is Professor of Geotechnical Engineering at the São Carlos Engineering School, University of São Paulo, Brazil. He obtained his Master's and Ph.D. degrees in Rock Mechanics from the University of California, Berkeley, under the supervision of Prof. R.E. Goodman. At the University of São Paulo, he is responsible for the post-graduate courses and research areas on Rock Mechanics and Underground Works. His main areas of interest are on optimization of excavation sequence for tunnels and shafts, the use of acoustic emission for the understanding of rock fracturing process, reliability of underground works and constitutive models of sprayed concrete for underground support. Among other temporary appointments, he was invited lecturer for the Master's Program on Underground Space Technology at the IHE - International Institute for Infrastructural, Hydraulic and Environmental Engineering, Delft, he Netherlands. He also holds a position at the engineering consulting company Themag Engenharia, in São Paulo, where he heads the groups of geotechnical engineering and engineering geology. He is responsible for the design of several hydroelectric power plants, metro tunnels and stations, tunnels for highways, water conveying systems, etc. He has acted as consultant in many projects in Brazil and abroad. He is President of the International Tunnelling and Underground Space Association – ITA. He was Vice-President for South America of the International Society for Rock Mechanics – ISRM. Having authored more than 130 technical papers, he is currently an Associate Editor of Tunnelling and Underground Space Technology (TUST, 2010- 2015). He is member of the Editorial Boards of Rock Mechanics and Rock Engineering TUST and other journals. He has authored more than 130 technical and scientific publications.

Søren Degn. Eskesen

Past President, International Tunnelling and Underground Space Association (ITA)
Chairman of the Danish Society for Tunnels and Underground Works

Mr. Eskesen obtained a Master of Science in Civil Engineering from the Technical University of Denmark in 1982 and a B. Comm. in International Economics and Management from the Copenhagen School of Economics and Business Administration in 1987.

Mr Eskesen is a Research and Development Manager in COWI's Tunnel and Underground Structures department who has more than 25 years of international experience in design and construction of tunnel and underground works. He is an experienced tunnel advisor with both technical and managerial knowledge of development of projects from feasibility studies, to tender strategies, detailed design and construction issues.

Mr Eskesen is the chairman of the Danish Society for Tunnels and Underground Works and the president the International Tunnelling and Underground Space Association ITA-AITES. He has been leading the development of the highly accredited ITA-AITES "Guidelines for Tunnelling Risk Management". Mr Eskesen authored several articles and papers on Risk Management and the development of tunnel and underground projects. He lectured in various international conferences as well as the ITA-AITES credited Master Course in TBM Tunnelling and ITA-CET training courses.

Alexandre Gomes, Vice President, International Tunnelling and Underground Space Association, ITA

Alexandre Gomes, a Civil Engineer having over 25 years of international experience in the design and construction of multidisciplinary tunnel and underground projects, geotechnical and geomechanical engineering, having been engaged in a number of major projects in Europe, the Americas, Asia and Australasia, from feasibilities studies up to the detail design, construction and commissioning stages.

Along his carrier he has gathered experience on a wide range of project types, including subway, railway, roadway, mining and hydro power plants, in different ground conditions varying from very soft ground up to hard rock tunnelling, with the use of mechanized EPB/TBM, conventional tunnelling and cut-and-cover techniques, among others. He has also extensive experience in the construction of large caverns in both soft ground and hard rock conditions.

Gomes received his degree in Civil Engineering at the Pontifical University of Goiás, Brazil, and started his professional career in Feb. 1992, working for the Geoconsult Group in Salzburg, Austria. He has been for over 13 years the Managing Director of Geoconsult Latinoamérica, with head-office in Santiago, Chile, overseeing the operation and development of projects in Latin America. Recently, he has joined SMEC (Snowy Mountain Engineering Corporation) as Chief Technical Principal Tunnels and Underground, in Sydney, Australia.

Published a number of technical papers and articles and on tunneling, geomechanics, geotechnics and underground works, also being involved in worldwide training activities for engineering professionals. He has been President of the Chilean Tunnelling Committee for over 5 years, member of the ITA Executive Council and is currently a Vice-President of ITA-AITES.

Over 30 years' global experience in Tunneling and Drilling applications and customers. He is currently a Vice President of Tunneling Drills in Sandvik Mining and Rock Technology.

Eric Leca, PhD

Eric Leca has thirty years' experience in the field of Transportation and Infrastructure. He spent the first part of his career in the French administration, where he was in charge of developing an R&D program in the field of Tunnel Engineering, at the Ecole Nationale des Ponts & Chaussées and then at the Laboratoire des Ponts & Chaussées (French road research laboratory), as Head of the Foundations, Structures and Tunnels Geotechnical Unit.

He joined the French engineering firm, EGIS in 1998 as Deputy Director of the Tunnel Engineering Division before moving to Australia where he became Managing Director of the Australia – Asia Pacific subsidiary of Egis Projects, involved in the project development and operation of transport infrastructure projects, before becoming Risk & Technical Director for the EGIS Group.

In 2005 he joined SYSTRA, a French engineering firm specializing in Mass Transit in Rail, as EVP for Engineering before becoming Group CTO in 2012, in charge of all technical divisions for Infrastructure, Systems and Operation (750 staff), with involvement in all major projects of the Group, in France and internationally.

He more recently joined the international engineering consultancy group, Arcadis where he has been leading the Rail & Urban Transport activity in Europe since January 2016.

Eric Leca holds an Engineer degree from the Ecole Polytechnique and the Ecole Nationale des Ponts & Chaussées in France, and a PhD from the Virginia Tech in the USA. Over his career, he has been involved in numerous tunnel projects - both at the design & construction stage, and during operation - and is the author of several publications in the field of tunnel engineering. He is currently Vice-President of the ITA-AITES.

Professor Jinxiu Yan,
Vice President International Tunnelling and Underground Space Association(ITA)

Professor Jinxiu Yan is currently the Vice President of the International Tunnelling and Underground Space Association(ITA); Vice President of the Chinese Tunneling and Underground Works Society and Deputy General Manager of China Railway Academy Co., Ltd. Prof. YAN has worked as consulting engineer for many major tunnel projects for 30 years. As research team leaders or experts appointed by the governments or the project owners, she have been involved in the construction of many major railway, highway tunnels and metro projects as well as long subsea tunnels in China such as the longest 32km long Guanjiao Railway Tunnel which is under construction; 18km long Qinling Railway Tunnel which has been completed in 1999; 13 km long Yesahnguan Tunnel in Karstic geology which has been completed in 2010; 18km Qining Zhongnanshan Highway Tunnel which has been completed in 2009; the longest (7.8km long) subsea highway tunnels in China, the Qingdao Jiaozhou Bay Subsea Highway Tunnel which has been completed in 2011 as well as 8.6km long Xiamen Xiang'an Subsea Highway Tunnel which has been completed in 2010. Prof Yan has won the Winner for 2012 China Economic Female

Entrepreneur Figures; Expert for enjoyment of China State Council Special Allowance for Outstanding Contribution to Engineering in 2011; Winner for the 5th Talent Prize of China Zhantianyou Development Foundation for Railway Science and Technology in 2008 as well as Winner for Tip-top talent by the Ministry of Railways, P.R.China in 2000.

Dr. Noppadol Phienwej, PhD, Past President of Thailand Underground and Tunnelling Group, Thailand Geotechnical Society, Engineering Institute of Thailand

Dr. Noppadol Phienwej is a senior faculty of Geotechnical Engineering and Geo-resources Field, School of Engineering and Technology of Asian Institute of Technology. He holds a doctoral degree in Civil Engineering from University of Illinois at Urbana-Champaign, U.S.A. He has 30 years of experience in geotechnical engineering as an academician and consultants. His areas of interest and expertise are underground excavations, tunneling, dam engineering and slope stability. He is also heavily involved with professional society and community service activities for instances, twice as advisors to the Minister of Transport of Thailand, advisors to a number of state enterprises responsible for infrastructure and utilities development. He used to serve as a liaison person of Thailand National Committee on International Tunnelling and Underground Space Association and was the past chairman of the group. He is currently the President and past Editor of the Geotechnical Engineering Journal of the Southeast Asian Geotechnical Society and serves on editorial board of two leading international journals, i.e. the Tunnelling and Underground Space Technology and the Tunnelling and Geomechanics. He was also the past chairman of the Geotechnical Committee of the Engineering Institute of Thailand and was also a member of its Executive Committee. He has been involved with a number of major infrastructure development projects in Thailand and Southeast Asian countries, i.e. Lam Ta Khong Pumped Storage Project, Nam Ngum2 HPP, Xaiyaburi HPP, Bangkok MRTA Blue Line projects, Mae Tang-Mae Ngad-Mae Kuang Water Transfer Tunnel Project, Ta Dam Dam Project, Kwaenoi Dam Project, Suvarnbhumi Airport Project, etc.. On research front he has been recently conducting research on application of advanced numerical computation to gain better understandings on problems related to urban tunneling and piled raft foundation.

Davorin Kolić, PhD

Born in Zagreb in 1961, Davorin Kolić obtained PhD from Faculty of Civil Engineering, University Zagreb. He won 3 times Rector's Prize the University of Zagreb. Since 1990 he has been active in underground projects as design manager, project leader on different tunnelling, subway or underground structures in Paris, Lille, Seattle, Puerto Rico, Munich, Vienna, Budapest, New Delhi, Seoul, Hong Kong, Singapore, as well as on several underground projects

in Northwestern China. In 2000, he was awarded first prize for the best international consultant of Austria for the Wanjiazhai Yellow River Diversion Project in China. Recently he is appointed as a project manager on project preparation of new railway Divaca-Koper, Slovenia. Davorin Kolić authored more than 100 scientific and technical papers, co-authored of one book and three guidelines on design and construction of underground structures in Austria and EU. He is also editor of 6 proceedings and books on tunnelling. Currently he is a president of Croatian association for tunnels and underground structures (ITA Croatia) and a member of Executive Council of ITA-AITES.

Giuseppe LUNARDI

Giuseppe LUNARDI is a Civil transport engineer, graduated from the Polytechnic of Milan. He has been CEO of Rocksoil S.p.A. since 2005. Rocksoil is a leading design company established in 1979 by Prof. Pietro Lunardi and operates in the field of geo-engineering having designed more than 1200 km of tunnels both with conventional and mechanized systems. As Rocksoil's CEO, he has taken part in the design and consultancy of the most important tunnelling work carried out in the past years in Italy and abroad, with special dedication in the propagation of the ADECO-RS approach for the design and construction of tunnels. Innovative spirit that has always inspired the design of Rocksoil led him to live close to the major experimental sites, such as that of Nazzano Tunnel, located near Rome, where the widening of an existing tunnel without interrupting traffic was successfully carried out for the first time over the world. He is also Vice-President of the Italian Tunnelling Society (SIG) with the delegation of President for the relations with foreign associations and ITA-AITES. He participated as a Lecturer to several Training Session of ITA-CET (Foundation for Continuous Education and Training on Tunnelling and Underground Space Use). From 2016 he is a Member of the ITA-AITES Executive Council and the tutor of WG12 – Sprayed Concrete Use.

Pekka A. Nieminen,

Born in Helsinki, Finland in 1959, he obtained M.Sc. in Mining Engineering from Helsinki University of Technology in 1986. Representative of Prime Sponsors in Executive Council of ITA-AITES. He has been working in underground mines in Finland prior to joining the Tamrock drilling equipment manufacturer, later acquired by Sandvik, in 1987. He has over 30 years' global experience in Tunneling and Drilling applications. Currently Vice President, Tunneling Drills in Sandvik Mining and Rock Technology