Foreword

of the President of the
International Tunnelling and Underground Space Association ITA-AITES

Søren Degn ESKESEN

Dear Colleagues and Friends

May 2015 has come and we are now gathering again for the World Tunnel Conference this year in beautiful Dubrovnik in Croatia to hold the ITA 41st General Assembly and WTC2015. This year’s topic is “Promoting Tunnelling in South East Europe” and gathering the whole ITA family on the Balkan Peninsula will definitely bring a boost of tunnel knowledge and technology to the region.

We see an increasing need for tunnels and underground space not just in South East Europe but all around the world. Wherever I look around the world, there is an increased need for new tunnels and use of the underground space. Tunnels and use of the underground space help our cities to become resilient by transforming surface problems to underground solutions and thereby improving living conditions for the citizens by reducing congestion, reducing air pollution and noise & vibrations impact. We, as tunnellers, are also helping our cities to provide drinking water and clean surface water by providing tunnels for drainage, flood control and sewer systems. With the increased growth in the world’s population and urbanisation the need for use of tunnels and underground space will continue to expand. ITA has performed a survey of the development in the global tunnel market. Over a period of 10 years the tunneling market has shown a steady growth in Europe, North and South America and Australasia with a global growth over 5% per year during the last decade. The major growth has taken place in Asia where the market has increased by approximately 15 times over a 10 year period. New market has developed particular in the Middle East where we now see a huge activity in the tunnelling industry where there

where hardly any market 10 years ago.

We therefore see a bright future ahead of us and we want ITA to play an important role in this. For that purpose we have launched the ITA Strategic Plan 2013-2016 which was accepted by the General Assembly in Iguassu last year. One of the initiatives we took was to initiate an ITA Young Members group, in order to attract young engineers and scientists to our Association and industry. With the increased growth we see ahead it is important that we are able to boost our human resources and know how in order to respond to our societies increased demand for the use of the underground. I am pleased that the ITA Young Member group is now very active and will meet in Dubrovnik.

In Dubrovnik, we will hear about all the latest development in technology and human resources as well as lessons learnt from projects all around the world. We will meet to hear the latest update, to meet good friends and to network exchanging knowledge and increasing our business opportunities. Our working groups and committees will issue their latest reports and will meet actively to progress the works.

I wish you all a successful conference and hope you will also get a flair of the Croatian lifestyle and culture along the Adriatic Sea.

Welcome to Dubrovnik.

Copenhagen, April 20th, 2015
Foreword
of the President of the Croatian Association for Tunnels and Underground Structures ITA Croatia
Dr.sc. Davorin KOLIĆ

Dear Colleagues,

It is our honour to be the host country for the organisation and preparation of the World Tunnel Congress 2015. At the same time it is our responsibility and duty to provide you the best possible conditions and services for your participation and networking that is highly appreciated on the occasion of the congress. We hope to be able to answer your requirements and expectations and we are looking forward to see you in Dubrovnik at the end of May 2015.

Tunnelling in South-East Europe has a long tradition coming from mining but during the last century the range of mining has decreased seriously. Underground works have been performed in last few decades as tunnelling works on transport infrastructure lines and hydro projects mostly. At the same time most of South-East Europe did not develop the use of underground space in urban areas: there is no subway or underground road or pedestrian systems in cities of Balkan Peninsula. This is one speciality that at the same time opens opportunities for future investors, clients and contractors.

However, developing one underground project is not an easy task: it needs preparation, interest, technical solutions, management, construction companies but above all it needs knowledge. Knowledge about planning, design, construction, supervision, equipment, financing and maintenance of underground structures.

This congress should be one important step and future milestone in providing missing knowledge about the use of underground space to countries of South-East Europe but as well to all other interested parties or regions where such development is missing as well. It should be the networking place opening contacts and possibilities over business forum core that is the part of the congress.

Welcome to Dubrovnik, the hearth of South-East Europe, the place of your future use of underground space.

Zagreb, April 15th, 2015
Preface

The Croatian Association for Tunnels and Underground Structures (ITA Croatia) and International Tunnelling and Underground Space Association (ITA- AITES) organize this year together a world tunnel congress 2015. The congress is organized with the title: "SEE Tunnel: Promoting Tunnelling in SEE Region" to develop the use of underground space in the South-East Europe region. Submitted articles are grouped within 13 different themes covering most of important topics presenting nowadays tunnelling experiences. Themes and topics presented herewith are recent international state-of-the-art practice applicable in other countries and in similar geological formations.

Session 1: "Planning and Designing Tunnels and Underground Structures"
The most articles of entire congress submissions are in this session and presenting leading projects worldwide within different project development phases.

Session 2: "Fire Safety of Tunnels and Underground Structures"
Presentation of active and passive fire safety measures and actions taken or planned for tunnels and underground structures in use or design and planning project development phases.

Session 3: "Mechanized Tunnelling in Development and Use"
Numerous submissions about different projects worldwide, new experiences and developments with materials in use and last experiences with new type of machines.

Session 4: "Operation and Maintenance of Tunnels and Underground Structures"
Presented are experiences from numerous projects worldwide as the number of underground structures is raising and as well the required need for their maintenance.

Session 5: "Developments in Use of Underground Space: Case Studies"
There are numerous examples of different projects using underground space in completely new, modern or interesting way. Case studies about recent applications are showing new approaches and possibilities of underground space use.

Session 6: "Cost Optimization and Financing of Underground Structures"
Tunnels are known as most expensive civil engineering structures but at the same time are bringing different benefits that are not included in direct construction cost estimations. Some of examples are presented as well as cost-overruns.

Session 7: "Immersed and Floating Tunnelling"
Application of different crossing locations are presented with specific problems and pertinent solutions, first ideas for the application of IMT technologies on new markets with no previous experience are indicated.

Session 8: "Intelligent Systems, Mechatronics and Robotics in Tunnelling"
Robotics and use of mechatronics technologies is coming more and more on markets and on to applications on underground projects. More and more machine prototypes are presented and first experiences as well.

Session 9: "Conventional Tunnelling Methods in Development and Use"
Different conventional tunnelling methods are presented and compared, complicated and special construction solutions are discussed, new conventional methods are presented for the first time over first experiences.
Session 10: „Urban Planning and Using of Underground Space“
How to start with the use of underground space and how to include underground structures in existing environment and surrounding is the work of urban planners specialized for underground space: some ideas and applications are showing recent developments.

Session 11: „SEE Session: Soft Ground Urban Tunnelling / Rock Tunnelling in Karst“
Session is dedicated to applications in SEE region and open to all participants with themes that could contribute to application in mentioned formations with existing or new ideas as well with experiences from previous projects in similar conditions collected around the world.

Session 12: „Risk Analyses and Techniques for Underground Structures“
Risk analysis is the part of design or management of underground structure today: whether regarding design, construction, cost or maintenance risks. Case studies and methodologies are presented within the session.

Session 13: „Equipment of Tunnels and Underground Structures“
Equipment as the part of the construction technology is present as well as equipment of tunnels that enable full tunnel usage and services.
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1.1. ELSAMNI Evaluation of applied SFRC as a steel replacement in the design stage in a part of Cairo Metro line No. 4

1.2. LEMKE Bonded strip termination for connecting tunnel cross passages

1.3. GILBERT Time-dependent Analysis of Macro-synthetic FRC Sections with Bar Reinforcement

1.4. JAMBRUŠIĆ REHABILITATION OF UNDERGROUND WATERS IN TUNNEL ŠUBIR

1.5. LUNARDI Copenhagen Cityringen Metro: EPB-TBM head pressure definition

1.6. NAKATA Research & Development and Management of Technology concerning a group of Expressway Tunnels (83km in total length) with large cross sections

1.7. SATICI Effects of paleo-rock landslide and heavy rainfalls to tunnel excavation

1.8. YANG Initial proposal and discussion on performance based waterproofing design for mountain tunnels

1.9. CHRISTER Rock mechanics in early design phases

1.10. BEZRODNY Construction of Escalator Tunnels of the St. Petersburg Subway

1.11. BUSSLINGER Tunnel climate - challenge during the Brenner Base Tunnel construction

1.12. RUSSO The Naples metro Line 1: the service tunnel at Toledo station

1.13. CHAUHAN Major cavity formation and its rehabilitation measures in headrace tunnel of RHEP-412 MW – A case study

1.14. SONG Steel fiber-reinforced concrete for precast tunnel lining segments

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1.18. HANSEN Rock mass characterization for Copenhagen Metro using face logs

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1.26. RING Two tunnel types with low soft overburden under horizontal stress

1.27. BANSAL Construction of a station over existing revenue tunnels

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1.36. RIBEIRO NETO Design and constructive method for Aricanduva Station of Sao Paulo Metro Line 2 (Green) Extension – Brazil

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1.39. SHEN Study on mechanics characteristics of tunnel structure crossing under high-rise building

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3.68. CHMELINA New Developments for Roadheader Navigation
3.69. COMAKLI Cutter Forces Measurement with (PLCM©) Using Mini Disc Cutters: Comparison with the Theoretical Models
3.70. NOVIN Comparison between simultaneous backfilling methods with two components and single component grouts in EPB shield tunneling

4. **Operation and Maintenance of Tunnels and Underground Structures**
4.1. LONGTIN Intelligent Lighting Control for Energy and Maintenance Savings
4.2. VALDES Development of Decision Support System on tunnel diagnosis
4.3. SRAMOON Water Transmission Tunnel Rehabilitation in Thailand
4.4. LI Solving Tunnel External Loads Based on Betti’s Reciprocal Theorem
4.5. KIM A Study on Development of the Performance Evaluation Index of Tunnels using the Delphi Method
4.6. MICHELIS Innovative waterproofing system for "Rivarolo" Tunnel
4.7. VOLLMANN Development of a highly ductile sprayed concrete as a counter-measure for explosion and fire impacts on underground structures
4.8. CHIU Lining crack evolution: a qualitative and quantitative index for degradation of tunnels in operation
4.9. SHIMAMOTO Floor Heave in Mountain Tunnels and the Effects of Countermeasures
4.10. TSUNO Influence of corroded segment joint on strength of shield tunnel
4.11. FORDYCE Developing a tunnel Operation and Maintenance Plan
4.12. GERLACH On-site tests on innovative automatic incident detection systems
4.13. LEI The Analysis of the Lining Cracks Caused by the Cavity behind Lining in the High-speed Railway Tunnel Based on XFEM
4.14. KAWAKAMI Utilization of IT and the Current Condition of the Repair Measures in the Maintenance of Subway Tunnels
4.15. JEON Stability analysis of damaged concrete jack lining in an urban cable tunnel
4.16. MAMMINO Structural outlines of the static and geostatic restoration proposed for two railways tunnels in a state of serious deterioration following instability inherent in the original phases of design and realization, which have risked collapse
4.17. HAFNER Road Infrastructure Security Manual - SecMan
4.18. OKAZAKI Project study of tunnels with time-dependent behaviour - Geochemical and mechanical characteristic of rock mass
4.19. MORIDI Underground Spaces Communication and Monitoring Systems integrated ZigBee and GIS
4.20. MURAYAMA Project study of tunnels with time-dependent behaviour-geochemical and mechanical characteristic of rock mass
4.21. WITTWER Use of thermography for tunnel-inspection
4.22. YASUDA Stress analysis of cylindrical tunnel with void behind the lining
4.23. VAN ZANTEN Repairing an ageing national monument - the world’s first box shaped immersed tunnel
4.24. ZHANG Numerical modeling of the seepage erosion process around tunnels using DEM
4.25. ZHANG Field study on tunnel lining resilience under extreme surcharge
4.26. NIWA Project study of tunnels with time-dependent behaviour - A diagnostic method using seismic velocity
4.27. SANCHEZ-DOMINGUEZ Automated Structural Evaluation of Tunnels in Service
4.28. YOO Tunnel lining behavior under high hydraulic head in water bearing ground – A numerical investigation
4.29. AI An automated and rapid measuring method for cross-section deformation of shield tunnels
4.30. YANG Evaluation Model of Technical Condition for Highway Tunnel Lining Structure Based on Matter-Element Theory
4.31. GJÆRINGEN Rehabilitation of Roadtunnels in Norway
4.32. SUZUKI A Risk Exposure Method of Tunnel Management for Expressways
4.33. CHOO Assessment of deterioration in underground structures using field inspection
4.34. KASHIHARA The First Application of CIM to a Tunnel Project in Japan
4.35. ITO Case study of a tunnel with time-dependent behaviour in a volcanic area of Hokkaido
4.36. NICKERSON Lake Mead Intake No. 3 - TBM Tunneling at high pressures
4.37. MOUSSAEI Evaluation of tunnel instability in layered structures using physical modelling

5.1. CARRARETTO TBM at the Meuse/Haute-Marne Underground Research Laboratory
5.2. SHAU Preliminary assessment of environmental impact for a high potential water inflow tunnel in Taiwan
5.3. TORRICO Design and construction of The San José Hydroelectric Project (Cochabamba, Bolivia)
5.4. FOGARASI Concept of Using Underground Space in Canadian Cities
5.5. JAVADI The Role of Operational Factors on Water Inflow to Unlined Rock Caverns
5.6. MAO Water Control of Vertical Shaft in Singapore
5.7. PAPADOPOULOU 3-D F.E. back analyses of two NATM tunnels in weak flysch
5.8. MASSINAS Settlement Analysis and Monitoring Instrumentation of Delhi Metro’s operational Line-2 tunnels during TBM, of new Line-8, underpass
5.9. PIAGGIO Swelling Rocks Characterization: Lessons from the Andean Region
5.10. POPIELAK Hydrostatic Pressure Control at Sanford Underground Research Facility
5.11. KUMAR NATM – Metro Tunnel Below Elevated Metro Line
5.12. JANUSZ Application of deep corrugated flanged structural plates for construction of vertical shafts and horizontal lining
5.13. GALERA Rock Engineering Aspects of the Cheves Hydropower Project Powerhouse and Transformer Caverns
5.14. GIL LÓPEZ Construction Project for the Rainfall Collector in Pinos Sub-basin, Madrid, Spain
5.15. DAMIANI “Piazza Meda” underground car park in Milan (ITA)
5.16. KALIAMPAKOS New Challenges in the Use of Underground Space
5.17. KHALI Construction of Railway Tunnels in Highly Adverse Geological Conditions in Himalayas by Using NATM – A Case Study
5.18. SUN Optimal anti-floating design of underground parking garage in Yitian town, Shenzhen
5.19. GONZALO Energy Efficiency studies for the Folgoso Tunnel. Introducing the new TUNELEC, a portable device for electrical measurements and tests in tunnels
5.20. MAHDAVI Highway Crossing for Sheppard East LRT Project in Toronto
5.21. SHARIFZADEH Effect of building’s geometrical Factors on the interaction of the tunnel-surface structures, the case of Niayesh Tunnel in Iran
5.22. SPINEDI Vezia - Crespera Cable Tunnel
5.23. VANNI Use of special jet grouting technologies for tunnel's crown and core advance consolidation: technical aspects and case studies
5.24. THAKUR Execution of Contact and Consolidation grouting in 162.5m deep, 38m dia Surge Shaft of 412 MW Rampur Hydro Electric Project, HP - India – A Challenging activity
5.25. CHA Numerical Analysis on Settlement Behavior of Shallow Box Tunnel Widening

6. Cost Optimization and Financing of Underground Structures

6.1. GUMUSOGLU A global cost estimation model for mechanized tunnels
6.2. TOWERS Effects of Risk Management on Project Insurance Costs
6.3. MOERGELI Risk-Based, Probabilistic Cost Estimating Methods
6.4. HUMBERT Site Investigations Reduce Cost Overruns in Tunnelling Projects
6.5. OCAK Cost Comparison of NATM and Umbrella Arch Method
6.6. POURHASHEMI Tunnel Monitoring During the Excavation Phase and Cost Optimization - a Case Study of Hakim Tunnel
7. Immersed and Floating Tunnelling
7.1. INGERSLEV Immersed Tunnels - Immersion Joints
7.2. BERGSMA Immersed Tunnel: A Viable Option for The Orlovsky Crossing
7.3. VAN WESTENDORP MOSE project Immersion of caissons within less than 10 mm
7.4. JELIC Conceptual design of immersed tunnel bridges of the Adriatic
7.5. JIN A Review of Foundation Treatment in Immersed Tube Tunnels in Mainland China
7.6. XU Research on Rapid Calculating Method of Seismic Analysis of Immersed Tunnel
7.7. MORTIER Assessment and Preservation of Immersion Joints
7.8. SAKAEDA Risk Management in Immersed Tunnelling Projects
7.9. XIAO Experimental Investigation on the Flexural Mechanical Behaviour of an Immersion Joint
7.10. YUAN Multi-shaking-table Test of a Long Immersed Tunnel
7.11. XU A Simplified Method for Calculation of Allowable Longitudinal Differential Settlement of Immersed Tunnel
7.12. KALMAR PEDERSEN The design of the Fehmarnbelt Tunnel

8. Intelligent Systems, Mechatronics and Robotics in Tunnelling
8.1. JEON BIM Application Case for Shallow Subway Tunnel Construction
8.2. INAGAKI Effective 3D Data Visualization in Deep Shaft Construction
8.3. ROEDER Cityringen Copenhagen: Innovative Groundwater Management
8.4. STENTOUMIS A Computer Vision System for Tunnel Inspection
8.5. BÖHNKE AID in Road Tunnels with Intelligent Loop Technology
8.6. FARJOW Novel Wireless Channel Characterization Model for Reliable Communication Networks in Tunnels
8.7. KUBOTA Tunnel Investigation based on Hammering Sound Analysis on Grassmann Manifold
8.8. BEDI Monitoring the deformations induced by large diameter SCL tunnels on existing tunnels for Victoria Station Upgrade, London
8.9. GAICH Circular 3D images from TBM's for geological mapping
8.10. LENSING Guiding and monitoring the Eurasia Tunnel construction under the Bosphorus Strait
8.11. LOUPOS Integrated Robotic System for Tunnel Structural Assessment - The ROBO-SPECT EC project
8.12. MARTÍNEZ DE OSABA Tunnel As-Built Analysis with Shotcrete Monitoring System GEOKRET
8.13. BARWART Disc Cutter Load Monitoring System - DCLM
8.14. CHENG Study on the Visual Scheme of Tunnel Detection Data Based on Web

9. Conventional Tunnelling Methods in Development and Use
9.1. MARCHINO A particular grouting application for the stability of a tunnel
9.2. SCHNEIDER New innovative system for layer thickness control on Normet spray mobile
9.3. WEI Liangwen Face Stability of Crossing River Shield Tunnel under Geological Conditions of Soft and Hard uneven Strata
9.4. DAL NEGRO Monte Ceneri Base Tunnel: a successful job-site experience
9.5. STEFANIZZI Analysis of the excavation of large caverns in the Sao Paulo Metro
9.6. BAUER Urban Tunnelling: The Vauxhall Underground Station Upgrade
9.7. FORTSAKIS Tunnelling in Weak Rock Mass with Overlying Competent Stratum
9.8. HU Freeze-Sealing Pipe Roof – Viable Tunnelling Technique in Soft Ground
9.9. OSTIADAL Open gallery solution for a tunnel on the National Railway
9.10. RUZICKA Prague experience from driving metro tunnels in developed areas
9.11. JIANG The field experiences of Spray-applied Acrylate Waterproofing Membrane for tunnels in alpine and cold areas
9.12. SRB Collapse of Březno railway tunnel made by prevault (Perforex) method in the Czech Republic
9.13. GRADNIK The Extension of the U12 Lot 3 in Stuttgart
9.14. NAKAYA Seismic survey using excavation blasting under tunnel construction -TFT Survey at road tunnel construction in Japan-
9.15. MARULANDA Tunnelling Experiences in the Andes Mountain Range
9.16. KIM Comparison of tunnel excavation cycle time for Norwegian and Korean tunnels
9.17. ZHANG Study on Key Technology of the Shed-tunnel Design and Construction
9.18. ZOVIC Non explosive method used for the widening excavation in a small diameter inclined tunnel
9.19. AYDAN The possibility of Infrared Camera Thermography for assessing the real-time stability of underground excavations
9.20. IMAZU An integrated study on the stability and dynamic response of the Taru-Toge tunnel during excavation
9.21. GJAERINGEN The Bjorøy tunnel - Blasting on the seabed above the tunnel running through the "Bjorøyzone"(Jurassic sediments in the fracture zone)
9.22. GAKIS Temporary sprayed concrete lining tunnels in Farringdon Crossrail station
9.23. FENEZIANI Numerical Analysis of Settlements due to Conventional Tunnelling
9.24. GALL Large cross sections for soft ground and soft rock conventional tunneling projects in urban areas – recent developments in the US
9.25. HASIK Metro tunnel under Cvetan Lazarov Boulevard in Sofia
9.26. KABIR Analysis of Tunnel Rock Cutting by Diamond Wire Saw Blade Using a Finite Element Model
9.27. OH Erosion performance with abrasive flow rate for abrasive waterjet rock cutting
9.28. OSS Design and excavation for the widening of a railway tunnel: the case of the Castellano tunnel in Italy
9.29. PAN Gongbei Port Tunnel Excavation Support Design and Construction
9.30. RYCHTECKY Metro tunnel with minimum overburden under a boulevard in Sofia
9.31. ŠINTIĆ Tunnel Excavation in Carbonate Rocks-Drilling and Blasting Calculation
9.32. STERPI GFRP Pipe for Tunnel Face Reinforcement: The Laboratory Characterization
9.33. SUEYOSHI Environmentally Low Impact Blasting In Urban Residential Area
9.34. HASIK A comparison of the use of spray applied waterproof membranes versus traditional sheet membrane waterproofing in the construction of deep level stations on the Prague Metro
9.35. YOO A Study on the Method of Using Camera and Laser Marker for Tunnel Face Mapping
9.36. ZENTI Semi-automatic tubular steel arch : an innovation on safety
9.37. ZHANG Field Test Research on Long Distance Horizontal Jet Grouting Pile for Pre-reinforcement in L7 Deep Weathering Rich Water Steep Dip Weak Stripe Area of Liangshang Tunnel
9.38. KIM Numerical Analysis of PSTM(Pressurizing Support Tunneling Method) using Reinforced Steel Beam for obtaining Constructability
9.39. LEE Tunnel excavation effect on pre-existing underground structure
9.40. OANCEA Study of solutions for realization of portals in difficult grounds
9.41. AGUIAR Design and construction aspects of a conventional shallow tunnel in very soft soil
9.42. BATYREV The first on-site comparison between NATM and ADECO-RS during construction of the “Dubler Kurortnogo prospekta” tunnels in Sochi (Russia)
9.43. CHORTIS Numerical Investigation of the Interaction between Twin Tunnels
9.44. PALMA FILHO The use of umbrella arch method and rebar spiles in the same road rock tunnel
9.45. KIM Case Study on the Application of Conventional Tunneling Method in Backfilled Ground Condition

10. Urban planning and Using of Underground Space
10.1. PASHKIN Optimization of geological researches for subway planning in Moscow
10.2. GYORGY Management of Effective Use of Urban Underground Space
10.3. SOH Psychological, Health and Social parameters associated with working in underground spaces
10.4. TYAGI Centrifuge modelling of Large diameter Tunnels in Improved soils
10.5. GALLI Lugano tramway System: a part of the public transport network
10.6. GLAZER Reviving burial in tunnels (#1871 - previously name "underground cemeteries")
10.7. FICALORA Procedure for Urban Infrastructure Project’s minimization due to the impacts of the undergrounds public service’s networks
10.8. GUO Numerical Analysis of influence of oblique Undercrossing Subway Shield Tunneling Construction on the Overlying Frame Tunnel
10.9. MERAND CANOPEE: programming, designing and construction of urban covers
10.10. BRAZA Feldkirch Tunnel system - First rockmade roundabout in the EU
10.11. BESNER Underground space use evolves via application of best practices

11. **SEE Session : Soft Ground Urban Tunnelling / Rock Tunnelling in Karst**
11.1. SAYADI The Role of Constitutive Model Selection on Tunnel Induced Subsidence in Urban Area
11.2. HARRIS Review of Ground Movements during SCL Tunnelling in an Urban Environment
11.3. ATZLTunnel Design for the Vienna Underground Construction Lot U1/9
11.4. ZHOU Modeling and optimization of ground freezing in tunneling
11.5. AMOUN Soil abrasiveness for EPB-TBM along Tehran metro tunnel line 7, Iran
11.6. BEDI Controlling the impacts of constructing a large diameter SCL tunnel on adjacent assets for Victoria Station Upgrade, London
11.7. HÖFER-ÖLLINGER New approach on characterizing Karst aquifers in tunnel design
11.8. FARGNOLI Soil-structure interaction during tunnelling: an integrated approach
11.9. FOROUGHI Evaluation of Long-term Settlement Induced by Shield Tunneling Case study: Tehran Metro Line 7 (East-West Lot)
11.10. St.JOHN POTTS Use of TBM pilots for large diameter SCL caverns: Crossrail C300/C410
11.11. VU The impact of shallow cover on tunnelling in soft soil
11.12. BOSCARO The first successful experience in Poland of tunnel excavation with EPB for the Metro Warsaw
11.13. LI Influence of slurry TBM parameters on ground deformation
11.14. NASSERY Estimating of Groundwater Inflow into the Sabzkuh Tunnel (Chaharmahal and Bakhtiari)
11.15. JEONG Ultrasonically Enhanced Material Properties of Liquid Grout

12. **Risk Analyses and Techniques for Underground Structures**
12.1. LU Influence on the existing building caused by shallow metro tunnel by excavation under crossing in short distance
12.2. MONIN Management of construction time and cost effectiveness by imple-mentation of the DAT software through the NeTTUN project
12.3. KAUNDINYA Identifying and Assessing Critical Road Infrastructure
12.4. CHEN Study on Effect of Excavation of Pit on Its Underlying Metro Tunnel
12.5. WANG Applying hydrogeological investigation to determine high potential zones of water inrush for a shaft construction
12.6. PARK Risk Analysis using Bayesian Networks Applicable to Shield TBM Tunnels
12.7. GARCIA ROBLES Non-Linear Motion Detection using SAR Images in Urban Tunnelling
12.8. CORRIOLS Integration of TBM-driving and surface auscultation data on a common web-based platform for global risk assessment. Application in Auckland Waterview Connection
12.9. HONG Tunnel Face Ahead Prediction on TBM using Tunnel Electrical Resistivity Prospecting System (TEPS)
12.10. JEON Flexural Performance Evaluation of Macro PET Fiber Reinforced Tunnel Shotcrete
12.11. KOHL Design and Cost Optimization using the latest Developments in Risk Analysis
12.12. MORADABADI Steps toward a probabilistic framework for tunnelling damage
12.13. LIU Evaluation of Transverse Seismic Calculation Methods for a Circular Tunnel in Soft Soil
12.14. SANDER Quantitative Risk Analysis - Fallacy of the Single Number
12.15. SCHUBERT Managing Residual Risk – a Case Study
12.16. SENTHILNATH Probabilistic Estimation of Operating Pressure for TBM Tunnelling
12.17. SHI Boundary Element Simulation of Tunneling Induced Pile Settlement
12.18. OU A study on the security effect of the construction of new subway station on parallel subway station structure
12.19. QI Harmful Gas Eruption Prediction and Its Protection Based on Solid-Fluid-Gas Coupling in Shield Tunneling
12.20. SEO Crack Detection in Pillar Structure Using Infrared Thermo-graphic Imaging
12.21. BOURGET Using risk analysis in construction tendering processes
12.22. CHEN A comparative study of mountain tunnel subjected to seismic load using 2D and 3D numerical simulations
12.23. WAGNER Risk Control In Planning Water Conveyance Tunnels
12.25. ROGUSKA Fuzzy risk matrix as a risk assessment method – a case study
12.26. GUPTA Risk Analysis in Tunnel Linkage of two cascade Hydro Electric Projects- 1500MW NJHPS (Nathpa Jhakri Hydro Power Station) with under-construction 412MW RHEP (Rampur Hydro Electric Project by Removal of 15m long Rock Plug of concreted 15.177km long, 10.5

13. **Equipment of Tunnels and Underground Structures**
13.1. MAMAGHANI Raise Boring Operation in Kure, Kastamonu Copper Mine
13.2. GELMI shaft sinking by drill and blast using the new concept service equipment for shaft "G18-GC30/15"
13.3. MASUKURA Operation analysis and effective inspection of Model-based predictive Ventilation Control (MPVC)