

**ITA - AITES**  
**MEMBER NATION 2017 ACTIVITY REPORT**  
**NATION MEMBRE - RAPPORT D'ACTIVITÉ 2017**

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PART 1: THE ASSOCIATION

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\*\*\*\* Name and address, E-mail, web site

- Name: Brazilian Tunnelling Committee (CBT)
- Address: Werner Bilfinger  
Av. Queiroz Filho, 1700 – Torre A, Sala 106 –  
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Brazil
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- Website: [www.tuneis.com.br](http://www.tuneis.com.br) or [www.braziliantunnelling.com.br](http://www.braziliantunnelling.com.br)

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\*\*\*\* Type of structure

CBT is a committee of the Brazilian Society for Soil Mechanics and Geotechnical Engineering (ABMS). It is an open society based on membership.

The board of directors is elected every two years. For the term 2017/2018, the board elected is composed by:

- Werner Bilfinger (President)
- Jairo Pascoal Júnior (Vice-President)
- Cássio Luis Abeid Moura (Secretary General)
- Fernando Leyser Gonçalves (Treasurer)
- Eloi Angelo Palma Filho (Executive Secretary)
- Adriano Dornfeld Saldanha (Events *ad hoc*)

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\*\*\*\* Number of members and type

- Corporate Affiliate Members: 23 (decrease of 20% when compared to the previous year)
- Individual Affiliate Members: 254 (decrease of 38% when compared to the previous year)

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\*\*\*\* Title of the journal (if any). Important articles published in 2017.

**Journal: Soils & Rocks** ([www.soilsandrocks.com.br](http://www.soilsandrocks.com.br)), in English, published by the Brazilian Society for Soil Mechanics and Geotechnical Engineering (ABMS), the Brazilian Association for Engineering Geology and the Environment (ABGE) and the Portuguese Geotechnical Society

(SPG). Three issues are released per year. As a sample, the following papers were published in 2017:

- Volume 40, N. 3, September-December 2017  
<http://www.soilsandrocks.com.br/soils-androcks/SR40-3.pdf>

#### MANUEL ROCHA LECTURE

Stress History of Soils from Cone Penetration Tests

P.W. Mayne 203

DOI: 10.28927/SR.403203

#### ARTICLES

Stabilised Soil Layers Enhancing Performance of Transverse-Loaded Flexible Piles on Lightly Bonded Residual Soils

N.C. Consoli, V.P. Faro, F. Schnaid, R.B. Born 219

DOI: 10.28927/SR.403219

Anchored Retaining Walls in Granite Residual Soils I – Parametric Study

N. Raposo, A.T. Gomes, M.M. Fernandes 229

DOI: 10.28927/SR.403229

Anchored Retaining Walls in Granite Residual Soils II. A Method for Preliminary Design

N. Raposo, A.T. Gomes, M.M. Fernandes 243

DOI: 10.28927/SR.403243

Influence of Traverse Velocity and Pump Pressure on the Efficiency of Abrasive Waterjet for Rock Cutting

P.B. Arab, T.B. Celestino 255

DOI: 10.28927/SR.403255

Rainfall Effects on Pore Pressure Changes in a Coastal Slope of the Serra do Mar in Santa Catarina

A.A.M. González, L.B. Passini, A.C.M. Kormann 263

DOI: 10.28927/SR.403263

Development of a Cyclic Simple Shear Apparatus

M.B. Corte, L. Festugato, N.C. Consoli 279

DOI: 10.28927/SR.403279

The Undrained Strength of Soft Clays Determined from Unconventional and Conventional Tests

S.G.F.P. Lemos, P.J.M. Pires 291

DOI: 10.28927/SR.403291

- Volume 40, N. 2, May-August 2017  
<http://www.soilsandrocks.com.br/soils-androcks/SR40-2.pdf>

#### ARTICLES

Energy Ratio (ER) for the Standard Penetration Test Based on Measured Field Tests

J.A. Lukiantchuki, G.P. Bernardes, E.R. Esquivel 77

DOI: 10.28927/SR.402077

Resistivity Piezocone in the Conceptual Site Model Definition

M.T. Riyis, H.L. Giacheti 93

DOI: 10.28927/SR.402093

Behavioral Evaluation of Small-Diameter Defective and Intact Bored Piles Subjected to Axial Compression

P.J.R. Albuquerque, J.R. Garcia, O. Freitas Neto, R.P. Cunha, O.F. Santos Junior 109

DOI: 10.28927/SR.402109

Deterioration Characteristic of Mudstone Due to Freeze-Thaw Action

Using Electrical Impedance Spectroscopy

J.C. Hu, H.F. Wang, J. Zhao 123

DOI: 10.28927/SR.402123

Influence of the Embedded Length on the Overall Stability of Single Anchored Retaining Walls

C.M. Santos Josefino, N.M.C. Guerra, A.N. Antão 133

DOI: 10.28927/SR.402133

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N.C. Consoli, E. Ibraim, A. Diambra, L. Festugato, S.F.V. Marques 147

DOI: 10.28927/SR.402147

On the Durability and Strength of Compacted Coal Fly Ash-Carbide Lime Blends

N.C. Consoli, R.B. Saldanha, J.F. Novaes, H.C. Scheuermann Filho 155

DOI: 10.28927/SR.402155

TECHNICAL NOTE

Seepage Induced Consolidation Model Correlation with Index Properties

M. Janbaz, A. Maher, S. Janbaz 165

DOI: 10.28927/SR.402165

CASE STUDIES

Behavior of Reinjectable and Prestressed Anchors in Soil Masses:

Construction Case Study in Congonhas – Brazil

T.B. Porto, A.C.A. Torres, R.C. Gomes 177

DOI: 10.28927/SR.402177

Three-Dimensional Geostatistical Estimation of Soil Units: A Case Study From Capitão Pocinho, Pará, Brazil

J.C.B. Queiroz, T.O. Vieira, P.P. Araujo, F.A. Matos, M.M. Amin, C.W. Salame 187

DOI: 10.28927/SR.402187

DISCUSSION

An Evaluation of the Shaft Resistance of Piles Embedded in Gneissic Rock  
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- Volume 40, N. 1, January-April 2017  
<http://www.soilsandrocks.com.br/soils-androcks/SR40-1.pdf>

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A Microstructural Cam Clay Model for Hydro-Mechanical Behavior of Unsaturated Soils  
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Pile Setup over a Period of Seven Years Based on Dynamic Load Tests in Overconsolidated Clay  
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Cavity Expansion Analysis to Predict Side Shear Set-Up in Clayey Soils  
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Statistical Modeling of Municipal Solid Waste Settlement from a Lysimeter  
C.L. Araújo Neto, B.M.A. Nóbrega, R.B.A. Sousa, M.C. Melo, W. Paiva, V.E.D. Monteiro 51

An Evaluation of the Shaft Resistance of Piles Embedded in Gneissic Rock  
E.L. Juvencio, F.R. Lopes, A.L.L.S. Nunes 61

**Electronic newsletter: [cbt@news](mailto:cbt@news)**, in Portuguese.

Issued at an average of three updates a month with news about the tunnelling industry, new projects, events and relevant information for CBT members and professionals from the tunnelling industry. Link: <http://tuneis.com.br/index.php/2016-04-27-12-48-30/noticias> .

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\*\*\*\* Major events of the association during 2017.

The activities of the Committee are classified in three groups:

- Institutional actions for promoting underground works in Brazil
- Technical activities
- Interviews

## ***INSTITUTIONAL ACTIONS FOR PROMOTING UNDERGROUND WORKS IN BRAZIL***

CBT has been heavily involved in promoting sustainable solutions of underground works when other types of disadvantageous solutions have been proposed. In some other situations, where underground solutions have already been selected, CBT has acted by suggesting improvements to the contracting process. A step backwards about this matter seems to have been taken in the country

as new contracting parties (both public agencies and private entrepreneurs), with little or no previous knowledge about underground construction, have tended to decrease the demand for engineering design and to transfer all the budget risk and responsibility to the contractor or prospective concessionaire. In some cases, actions taken by CBT have reached the media including the most important newspapers in the country.

The Brazilian Committee of Tunnels - CBT, promoted in 2017 the first edition of the Prize Prof. Figueiredo Ferraz. With the objective of encouraging the production of Undergraduate Work, the award will be for students who can compete directly with their Completion Works (TCC), or Scientific Initiation, in the areas of design and construction, operation, maintenance and reinforcement of tunnels, underground works and underground space planning, submitted and presented in the year of the edition or the previous year, always having undergraduate students in the submission period.

### ***TECHNICAL ACTIVITIES***

The following events counted with CBT organization, sponsorship or participation:

#### **MARCH**

On **March 9th**, Geologist Magali Gurgueira gave a lecture entitled "Geology Applied to Tunnel Engineering: examples of cases in São Paulo", which had more than 70 participants, demonstrating the interest that the subject causes. The speaker participates in the Young Members CBT Group since its inception and during the lecture was supported by its tutors: Engineer Rogério Martinati, with well-known experience in tunnels, and Geologist Luiz Ferreira Vaz, author of the weathering profile commonly adopted in São Paulo.

On **15 March**, Herrenknecht AG, a German company, one of the world's leading manufacturers of TBMs, member and supporter of the CBT, gave a lecture on the "Advancement in mechanized construction technology for tunnels and wells" presented by the engineers Edson Peev and Renato Alessandri Junior. With a technical approach on the innovations in its TBM (Tunnel Boring Machine) equipment, cases of works currently carried out with its equipment worldwide, as well as mini-shields technology for application in water, gas, electric and logic networks, the talk excited designers, contractors, industry and consultants.

#### **APRIL**

Between **April 3 and 5**, the 4th Brazilian Congress of Tunnels was held, together with Latin American Tunneling - LAT and the 9th IS, a joint event that had more than 500 participants and 30 exhibitors. Before the event, on March 31 and April 1, the traditional Pre-Congress Course was held, with more than 60 participants.

On the occasion of the 4th Brazilian Congress of Tunnels, the Brazilian Committee of Tunnels (CBT) paid special tribute to Eng. Akira Koshima and contractor Toniolo, Busnelo S/A.

The tribute to Eng. Akira portrays the gratitude of all the tunnel community in Brazil, especially those who are part of the Committee, to this self-sacrificing worker for the common good. In addition to being President of the CBT and Board member on other occasions, Akira always brings to the group a lot of energy and peace, fundamental factors to the success of the big events that are often organized by the Committee.

As for the company Toniolo, Busnello S/A, the special award is a recognition to the group that has specialized in underground works for decades. TBSA is a constant investor in state-of-the-art technologies, which reflects on works delivered on time and on the reliability acquired from the contractors.

In the scientific part, the 4th CBT awarded the paper "*Teor de Quartzo Equivalente ou Grau de Alteração? Qual destes Parâmetros é mais importante nos Estudos de Abrasividade em Regiões Tropicais?*" as the best article in the Congress. The award was presented by Eng. Luis Sózio, president of the Technical-Scientific Committee 4º CBT, to the winners Hugo Cássio Rocha and Marcelo D. Monteiro, both of the Metrô-SP.

Also in this event, the CBT granted the award of the 1st edition of the Prize Prof. Figueiredo Ferraz. The award is intended to encourage the production of undergraduate works, and may compete for TCC - Completion Works - or Scientific Initiation Works, in the areas of design and construction, operation, maintenance and reinforcement of tunnels, underground works and underground space planning. In this first edition the prize was given by the daughter of Eng. José Carlos de Figueiredo Ferraz, Mrs. Lia de Figueiredo Ferraz, to the first and second place.

1st Place Thiago Pereira Perez; José Carlos Monteiro; JoséIVALDO Alves; Rodrigo Buccioli Pereira for the work: Construction of Tunnels in Urban Areas with EPB Tunneling Machine.

2nd place Gabriela Reis Piazzetta by the work: Application of the laser scanner in the stability analysis in underground excavations: Mina Tabiporã, Campo Largo - PR.

## **MAY**

On **May 11**, Pedro P. Cacciari, winner of the Icaray Silveira Award - ABMS (biennium 2014-2015), presented his award winning work "*Modelagem de túneis em rocha utilizando scanner a laser terrestre e redes discretas de faturamento*" in the auditorium Business Center Villa Lobos Office Park.

The Speaker talked about the mapping and analysis of geological discontinuities are extremely important for modeling tunnels in rocky massifs.

The use of 3D images generated by TLS makes it possible to perform the mapping in digital form, overcoming limitations and allowing the determination of geometric parameters (orientation, length and position) of all discontinuities.

The Monte Seco tunnel (located at EFVM) was used as an object of study for the application of these techniques and automation of procedures that allow the generation of discontinuous models similar to the local rock mass. These models are used to perform stability analyzes using the

discrete elements method (3DEC).

On **May 25**, CBT, in partnership with the Rio de Janeiro Regional Nucleus - ABMS, ABGE, CBMR and Clube de Engenharia, promoted the lecture "*Túnel de Via da Linha 4-Sul do Metro do Rio de Janeiro- Aspectos de Projeto e Executivos*", given by Eng. Pedro Teodoro França, Manager of the Excavations Department of CJC Engenharia de Projetos.

The lecture presented aspects related to the project and the execution of the track tunnel of Line 4-South of the Metro of Rio de Janeiro, with the presence of about 100 participants of the technical environment of the city.

The complexity of the work, with excavation of low coverage in densely occupied urban area, the evaluation of risks of damages in the buildings and the arrivals and departures of the stations were some of the topics covered.

## JUNE

The World Tunnel Congress 2017 took place in Bergen, Norway, from **11 to 14 June**. A 12-member CBT entourage - led by committee chairman Werner Bilfinger - represented the Brazilian tunnelling community. The opening ceremony was attended by Tarcisio B. Celestino, president of the International Tunneling and Underground Space Association (ITA) and former president of the CBT, and the presence of the prince of Norway, Haakon Magno.

The theme of WTC 2017 was "Surface Challenges - Underground Solutions". The choice is due to ITA's commitment to sustainable development.

## JULY

PUC-Rio organized the seminar Engineering of Tunnels in Brazil. The event, which took place on **July 4**, was attended by the president of ITA and former president of CBT, Tarcisio Celestino, who approached the history of the tunnels. With about 80 participants, the seminar was dedicated to graduate students and was coordinated by Alberto Sayão, a professor at PUC-Rio and a former president of ABMS.

On **July 27**, CBT President Werner Bilfinger ministered the lecture "*Recalques na obra do Porto Maravilha*" at the GeoSUL event, which is held every two years in Rio Grande do Sul, Santa Catarina or Paraná states. In 2017 was headquartered in the city of Bento Gonçalves (RS), bringing together more than 300 professionals and students from the three Brazilian states.

## AUGUST

In partnership with the Brazilian Waterproofing Institute (IBI), CBT held the seminar on Integrated Waterproofing Solutions - Case Study, during the Concrete Show in São Paulo, on **August 25**, with 30 participants.

The event began with presentations by Leonardo Tomio Katayama and Marco Aurélio Peixoto, engineers of the construction company Andrade Gutierrez, who spoke about the fabrication of the Prefabricated Rings for the Shield Tracks in Line 5 of the São Paulo Subway. The speakers presented the design, quality and manufacturing details applied in Lot 3 of Line 5 of the SP Subway.

Next came Igor Maria Zotti, executive director of Soprema Brasil, and Nicolau Giovanetti, engineer and managing partner of Pires Giovanetti Guardia (PGG), who approached the waterproofing of the Nueva Gambetta Tunnel in Callao, Peru. The road tunnel Nueva Gambetta began to be built in 2015 and the work was completed in the year 2016. It has the extension of approximately one kilometer and a waterproofing area of 300 thousand square meters.

On **August 31**, the Brazilian Tunnel Committee presented to the tunnel community in São Paulo a broad panel on the advances, technical innovations and themes discussed during the World Tunnel Congress (WTC) 2017, held in Bergen, Norway, on 9 to 15 June this year (Echoes of Bergen).

The technical exposure of the WTC 2017 has also caught the attention of Brazilians, and was reported on occasion as an example of the new research and monitoring technologies that are becoming increasingly common, such as mapping the tunnel from images using 3D glasses.

The event was attended by 150 people, and online transmission with up to 100 simultaneous accesses.

## SEPTEMBER

Address the importance of waterproofing and the need to protect the structures of metropolitan tunnels. This was the objective of the lecture "Waterproofing of Metropolitan Tunnels and Underground Structures - Analysis of New World Trends and Project Guidelines Based on Geological and Local Geotechnical Characteristics" (*Impermeabilização de Túneis Metropolitanos e Estruturas Subterrâneas – Análise de Novas Tendências Mundiais e Diretrizes de Projetos Baseados em Características Geológicas e Geotécnicas Locais*), held on **September 27** in São Paulo.

The lecture, organized by CBT in partnership with Soprema, a company associated with the Committee, was led by engineer Igor M. Zotti, executive director of the company. The event brought together more than 60 people.

## OCTOBER

No dia **3/outubro**, Cássio Moura, engenheiro e Secretário-geral do CBT, ministrou o minicurso "Concreto Projetado Teoria e Prática", organizado pelo Núcleo Rio Grande do Sul da ABMS. O encontro aconteceu na Universidade de Caxias do Sul (UCS), em Caxias do Sul.

O minicurso teve como tema central **Concreto Projetado em Túneis** e contou com a presença de aproximadamente 40 pessoas, público formado basicamente por estudantes do quarto e quinto ano de engenharia.



On **October 3**, Cássio Moura, Engineer and Secretary General of the CBT, ministered the mini course "Sprayed Concrete Theory and Practice" (*Concreto Projetado Teoria e Prática*), organized by the Nucleus Rio Grande do Sul of ABMS. The meeting took place at the University of Caxias do Sul (UCS), in Caxias do Sul.

The mini-course was centered Sprayed Concrete in Tunnels and had the presence of approximately 40 people, public formed basically by students of the fourth and fifth year of engineering.

## **NOVEMBER**

On the 27th anniversary of the CBT, celebrated on **November 8th**, the Committee, the São Paulo Nucleus of ABMS and Maccaferri held the lecture "*Soluções para Emboque de Túneis com Malhas de Proteção*". The event brought together more than 50 people in the CBT auditorium in São Paulo.

The ABMS Northeast Nucleus organized the 5th edition of GeoNE (Geotechnical Symposium of the Northeast), in Maceió (AL), on 16 and 17 November. The meeting was attended by the secretary general of the CBT, Cássio Moura, who coordinated the presentation of the case study "Geotechnical treatments in the excavation of tunnels in soil", on **November 17**.

GeoNE was attended by more than 500 people, in addition to six lectures and 18 works.

## **DECEMBER**

On **December 4**, the Day of Santa Barbara, CBT held the first edition of **Tunnel Day**, promoting a technical event about Bolts for Rock Tunnels. The event held at the Engineering Institute of São Paulo was attended by more than 120 people, in addition to a live webcast.

The idea of CBT is to promote a Tunnel Day every year, chosen a technical theme to involve the tunnel community.

## **INTERVIEWS**

- On **October 2**, "*O Globo*" newspaper published a story about the 600-meter tunnel excavated by a gang that sought to rob Banco do Brasil Bank in São Paulo. For the technical analysis, the report was attended by Werner Bilfinger, president of CBT. The engineer spoke about how precarious the tunnel was built and the possible problems that can happen in a work done in this way.
- In **October**, CBT launches series of reports "Underground Tunnels and Structures - thought and research in Brazilian universities".
- ✓ First interview, in October, was with Professor Andre Assis, Universidade de Brasília - UnB. Link: <http://tuneis.com.br/index.php/2016-04-27-12-48-30/noticias/item/768-andre->

[assis-professor-titular-da-universidade-de-brasilia-fala-sobre-as-linhas-de-pesquisa-na-universidade-inovacoes-tendencias-futuras-e-capacitacao-profissional-na-area-de-tuneis](#)

- ✓ Second interview, in November, was with Professor Sérgio Fontoura, PUC-Rio. Link: <http://tuneis.com.br/index.php/2016-04-27-12-48-30/noticias/item/779-forcas-do-mercado-limitam-a-atuacao-dos-tuneleiros-afirma-sergio-fontoura-em-entrevista>

\*\*\*\* Summary in 4 lines of part 1 to be published in TRIBUNE.

In 2017 the CBT organized the 4<sup>th</sup> Brazilian Tunnelling Congress that was a success, even in an economic crisis. At the event was awarded the best Monography of graduation students in first edition of Prof. Figueiredo Ferraz Award. To conclude the year, CBT promoted the firsts Tunnel Day, in december, 4, where a technical discussion was about Bolts to Rock Tunnel.

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## PART 2: ACTIVITY OF THE NATIONAL WORKING GROUPS

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\*\*\*\* Summary in 5 to 10 lines of the activity of the working groups.

In 2017, discrete activities in National Working Groups.

In ITA Working Groups, the participation was:

| ITA - WORKING GROUPS  |   | Proposed member by the MN<br>Membre proposé par la NM |  |
|-----------------------|---|---|--|
| <i>n</i> <sup>o</sup> | Topic   | Family Name, Given name                               | <i>E mail</i>  |
| WG2                   | Research  | Felipe Gobbi  | <a href="mailto:felipe.gobbi@geobrugg.com">felipe.gobbi@geobrugg.com</a> ;<br><a href="mailto:felipe.gobbi@gmail.com">felipe.gobbi@gmail.com</a> |
| WG3                   | Contractual practices in underground construction | Tiago Ern   | <a href="mailto:tiagoern77@gmail.com">tiagoern77@gmail.com</a>   |
| WG5                   | Health and safety in works                        | Edson Peev  | <a href="mailto:peev.edson@herrenknecht.com.br">peev.edson@herrenknecht.com.br</a>   |
| WG6                   | Maintenance and repair of underground structures  | Bruno Leonardo Rossi                                  | <a href="mailto:brunolrossi@gmail.com">brunolrossi@gmail.com</a>   |
|                       |   |   |  |
| WG11                  | Immersed and floating tunnels                     | Mário Luiz Medrano                                    | <a href="mailto:mlomedrano@yahoo.com.br">mlomedrano@yahoo.com.br</a>   |
| WG12                  | Sprayed concrete use                              | Cássio Abeid Moura                                    | <a href="mailto:cassio@concretoprojetado.com.br">cassio@concretoprojetado.com.br</a>   |

|              |                                     |  |  |
|--------------|-------------------------------------|--|--|
| <b>WG 14</b> | Mechanisation of excavation         | <b>Hugo Cássio Rocha</b>                   | <a href="mailto:hcrocha@metrosp.com.br">hcrocha@metrosp.com.br</a>                   |
| <b>WG 17</b> | Long tunnels at great depth         | <b>José Ademar de Mello Franco</b>         | <a href="mailto:jadelmar@terra.com.br">jadelmar@terra.com.br</a>                     |
| <b>WG 19</b> | Conventional tunnelling             | <b>Werner Bilfinger</b>                    | <a href="mailto:werner@vector.com.br">werner@vector.com.br</a>                       |
| <b>WG 22</b> | Information Modelling in Tunnelling | <b>Jairo Pascoal Júnior</b>                | <a href="mailto:pascoal.jairo@gmail.com">pascoal.jairo@gmail.com</a>                 |
| <b>YM</b>    | ITA Young Member Group              | <b>Fernando Carvalho de Oliveira Abreu</b> | <a href="mailto:cassio@concretoprojetado.com.br">cassio@concretoprojetado.com.br</a> |

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### PART 3: UNDERGROUND ACTIVITY

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\*\*\*\* Up to 20 lines to be published in the activity report in TRIBUNE concerning the significant projects under construction or in study.

Still in the phase of national economic stagnation, no significant new works are reported for the year 2017, but only continuities or conclusions of undertakings that were already under way.

In that year, the tunnels of the Serra do Cafezal, highway BR-116/SP, were completed and released to traffic. Also, the civil work of the Jaguari-Atibainha adductor tunnel, with 6.4 km of extension, was completed after 18 months.

In progress, the works of the Rodoanel Norte do São Paulo continue; Ring Road of São Sebastião and Caraguatubá; of the New Ascent of Tamoios; and the implementation of the Blue Line in Salvador-Bahia.

\*\*\*\* Other information to be published as news in the ITA website.

- The Brazilian Young Members Group – CBTYM, with more than 400 registered, and promoting sequential events.
- Members affiliated to CBT: Corporate Affiliate Members: 23 (decrease of 20%) and Individual Affiliate Members: 254 (decrease of 38%)
- CBT news was constantly updated in the Website, Facebook and Twitter pages throughout 2017.

===== END =====