

Edito



Twenty-seven years ago, François Schlosser and Alain Guilloux suggested that I join them in their project to develop Terrasol into a benchmark player in geotechnical consulting and expertise. Now that the time has come to

change the way I live for the best years of the rest of my life, when I look back on the path that has been covered, I can only marvel at the "dynamic" process then undertaken and which still drives Terrasol. So for me it is the opportunity to stress the importance of the values of welcome and transmission, precisely those of apprenticeship and mentorship, which give their nobility to so many professions. I take great satisfaction in seeing that I am followed in the position of Scientific Director by Fahd Cuira, with whom I have worked since his arrival at Terrasol, like with many others. For it is certainly by welcoming, training and guiding younger people, all called upon to contribute to the future of the company, that Terrasol has been able to adapt itself continuously to the changes in its environment. These young people (average age 34) are among the riches of Terrasol, in the same way as the multiple cultures of its engineers (approaching 10 nationalities) or the substantial progress already made towards parity between men and women.

Furthermore, at a time when networks are placed in the spotlight, it must be emphasised how bringing together diverse and complementing competencies (field work, analysis, computing, development, etc) in the same company constitutes, and has done for a long time now, a "network", an "incubator", where everyone knows that they can always find the answers to their questions. Terrasol has also always been connected to external networks (learned societies, universities, research units), which stimulate its interest and help it direct its curiosity towards the development of new competencies.

The various projects and actions reported in this newsletter bear witness to the fact that this dynamism is still flourishing.

I will take great pleasure in continuing to share my experience and continue this mentoring work with Valérie Bernhardt, Hervé Le Bissonnais and their teams.

B. Simon

Nîmes - Montpellier Railway Bypass



Credit: OC'Via - Yannick Brossard

TERRASOL has been working on the Nîmes - Montpellier railway bypass since 2010, first of all on the occasion of the response to the proposal by the OC'Via Construction group (BOUYGUES), followed by the project (preliminary and detailed) design studies. For these studies, TERRASOL, alongside SYSTRA, had defined the necessary geotechnical testing programmes (phases BC1 to BC4), then carried out the geotechnical design studies for the standard engineering structures of the "Gard" works package (from Vidourle to Manduel), and lastly took part in the studies for the two special engineering structures (Lez Viaduct and Manduel cutting). A total of nearly a hundred structures had been studied by spring 2013.

As part of the detailed geotechnical works design, the OC'Via Construction group subsequently contracted TERRASOL to update the geotechnical design studies for the engineering structures of works package "Hérault" and "Gard". This contract covered the incorporation of the latest available data from the additional soil-testing campaign (series BC5 to BC8, focusing on the karst issues among other aspects) and, if possible, optimisation of the geotechnical parameters used for the foundations design. Worth mentioning in particular is the grade separation RL015-2, carrying the future track V2 of the Lattes connection over the existing Tarascon-Sète line. This structure is part of the "Hérault" works package and is located in a difficult geological context: the limestone massif, subcropping in the South zone of the structure, plunges abruptly and to great depth in the North zone of the structure, below the quaternary and tertiary formations of the coastal plain. In addition,

karstification processes are affecting this limestone substratum. The foundation techniques consequently chosen for the structure combine karst treatment grouting, shallow foundations, piles anchored into the rock and floating piles in the tertiary formations. This update of the geotechnical studies for more than 160 civil engineering structures was carried out from October 2013 to November 2014 and was concurrent with the studies of the hydraulic structures.

In parallel, TERRASOL is working actively on site. In the spring of 2014, an engineer worked in the geotechnical unit of the technical department to ensure coordination between studies and works, and for monitoring the completion of the foundations works. Since May 2014, an engineer has been seconded to the Works Management team, with duties including inspection operations. Among all the geotechnical issues encountered, three topics are the focus of most of the activity of the geotechnical services:

- Problems related to the karsts and to their backfilling ; 3 separate limestone formations are undergoing in-depth studies and treatments.
- Monitoring and checking of the foundations of the engineering structures, and in particular the piles: a real challenge in view of the number to be completed (more than 1200). As of the beginning of December 2014, around 80% of the piles have been completed.
- Monitoring of the challenging jet-grouting operations under the existing SNCF (French railways) tracks for the Manduel cutting.

Our presence on site will be maintained on the first half of year 2015.

G. Chapron, B. Madinier and F. Asselborn

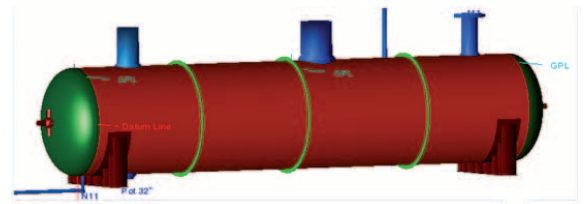
STIR Bizerte

Tunisia

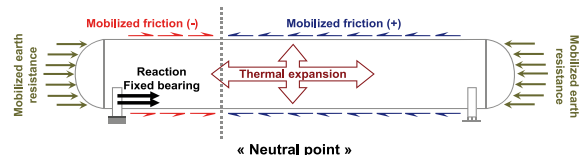
TERRASOL recently assisted the Italian company TANKO SPA, which builds 'cigar' tanks – an innovative concept for storing LPG – in the framework of a project in Bizerte, Tunisia.

Intended for the Société Tunisienne des Industries de Raffinage (STIR), these cylinders buried in a compact backfill are subject to temperature changes. TERRASOL's task: calculate and optimise the thermal loads exerted on the tanks at the fixed support points (slab on piles) taking into account the tank / backfill / foundation block interaction mechanisms. Without involving numerical processing in three dimensions, these interactions could be investigated in a satisfactory manner using the Thermopie program (developed by TERRASOL originally for the design of geothermal foundations), using as input parameters:

- The result of a PLAXIS 2D model for a cross-section of the tank, intended to assess the normal stress state around the tank (and consequently the lateral friction mobilisable longitudinally);
- The result of a Groupie+ model (FOXTA software) used to quantify the lateral response function at the top of the foundation block.



© TANKO SPA



F. Cuira and B. Simon

'Borne Romaine' Tunnel

Alpes Maritimes, France

The 'Borne Romaine' section of the A8 motorway between Nice and La Turbie (in the Alpes-Maritimes region, south-east of France) is located on an unstable slope. The mitigating measures implemented and the diversion of one carriageway on the side towards the mountain have turned out to be insufficient to ensure the long-term stability of the structures. That's why the motorway management company ESCOTA decided to build a tunnel in the slope to accommodate one carriageway and thus move the whole road system out of the unstable zone.

The works, carried out under project management by EGIS Tunnels, were contracted at end-2013 to the consortium CAMPENON BERNARD TP Côte d'Azur – GTM Sud – SOLETANCHE-BACHY-TUNNELS – EUROVIA. TERRASOL has then been entrusted by the consortium with the whole detailed design (supports, linings, structures, utilities), with contribution from BMCI (subsidiary of SETEC TPI) for the structural aspects.

The structures to be built comprise a tunnel 800 m long excavated in a good quality limestone massif, a safety tunnel 80 m long between the mid-point of the main tunnel and the open air, and the portal structures and equipment (architectural walls, tunnel substation, fire-fighting water basin and water recovery basin). Half of the tunnel has now been excavated, and works on the safety tunnel are starting.



Credits: GTM – Campenon Bernard

J. Marlinge

Expertise on the Jacqueville bridge

Ivory Coast

The Jacqueville bridge links Jacqueville with the mainland across the Ebrié lagoon west of Abidjan (Ivory Coast). This structure has 16 supports (2 abutments, 14 piers), 13 of which are built in the lagoon. Works started in 2012 with the boring of large-diameter (1.20 m) piles, at depths down to more than 50 m in some cases. Investigations performed on the piles after construction showed bearing capacity defects on a large number of supports. After attempting to reinforce the deep foundations by grouting on three supports without reaching the target result, the owner (AGERROUTE) called upon TERRASOL for the following tasks:

- Detailed analysis of the geotechnical context of the supports concerned (P4, P14 and C16),
- Validation/proposal of a method for modification of the foundation system by addition of extra piles,
- Calculation of the new foundation system.



Addition of piles under the headers raised the problem of the proximity of the abandoned piles, which disturbed the friction and the tip behaviour of the piles, but also the question of the capacity of the new piles under horizontal loads in a disturbed environment. Several bracketing calculations were performed using the Fondprof, Taspie, Tasneg, Piecoef and Groupie modules of the FOXTA program in order to determine the behaviour of the foundation and validate the repair principle. These calculations enabled to proceed with the works on site, while globally maintaining the geometry of the planned headers.

J. Drivet and U.S. Okyay

South-West Red Line of the New Greater Paris

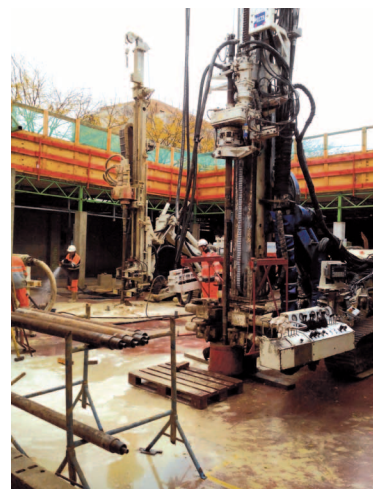
Paris, France

As mentioned in a previous newsletter, TERRASOL has joined the project management team of works package 3 of Greater Paris line 15 (between Pont de Sèvres and Villejuif). This consortium, with Setec TPI as lead company, is responsible for 8 stations and 12 ancillary structures within 12.5 km of tunnel.

The studies began in September 2013. The consortium carried out the detailed preliminary design studies in two successive phases of 7 and 6 months. TERRASOL is responsible for all the geotechnical aspects of the project: synthesis of geotechnical parameters, production of the longitudinal profile, risk management relating to quarries, soil-structure interaction calculations for the stations, ancillary structures and the tunnel. This phase of the studies has just been completed. The detailed design phase was started in December 2014 with a design report due in June 2015 and the issuance of tender documents in summer 2015.

In parallel, the first Greater Paris works were started in September 2014 for the construction of an exploratory shaft and gallery at the location of the future Arcueil-Cachan station. The purpose of these works is to test jet-grouting in quarry backfill and the Ypresian layer (including its sandy facies); it will enable full-scale analysis of the behaviour of the plastic clay (deformation measurements, rigid plate loading tests, back-analyses, etc). TERRASOL is taking an active part in monitoring these works, which will produce many types of critical information for the project as a whole.

G. Chapron and H. Le Bissonnais



Trinity Tower

La Défense, France

The Trinity tower project is located on a slab over the RN192 main road in La Défense (west of Paris). Its foundations will be built without interruption of the traffic. These constraints have resulted during the detailed design phase in the choice of foundations comprising rows of micropiles with a row of buttresses to take up the horizontal loads. These foundations are anchored in the Lutetian marls and stones layer, immediately above the coarse limestone slab and the Ypresian clayey layers, the behaviour of which has an impact on the long-term settlements of the tower. The two major aspects of the TERRASOL study are:

- The synthesis of the soil data: the emphasis was placed on the determination of the deformation moduli, based on many types of soil testing and on feedback from the neighbouring towers in the district. These moduli are the input data for our study and are assessed consistently with the calculation model used.
- The overall 3D calculation model in PLAXIS: the foundations rows represent several thousand micropiles and piles. They have consequently been modelled by elements of equivalent volume adjusted by means of very detailed models for the behaviour of the micropiles and of their group effect.

On the basis of this overall model, the soil-structure interaction matrix has been defined for the foundation system: it is valid within a precise range of loading. This matrix has been used to optimise the discussions with the structural engineers and has enabled to obtain a similar settlement profile for the soil model and the structure model from the first iteration: the calculated maximum settlement is of the order of 3 to 4 cm in the long term.

A. Bergère

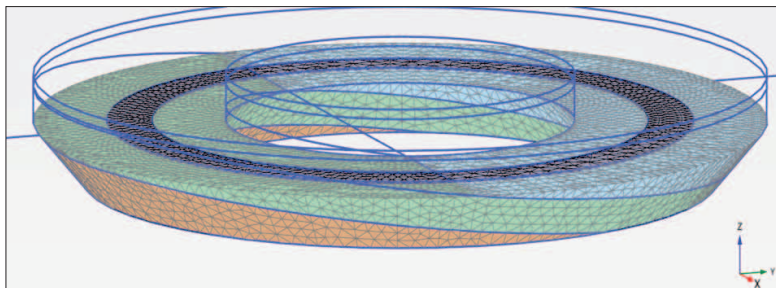


Credits: SCI TRINITY DEFENSE (UNIBAIL RODAMCO) / Crochon Brullmann + Associés / L'autre Image Production

EPR UK at Hinkley Point

United Kingdom

In the context of the construction of the British EPRs (Evolutionary Power Reactors), TERRASOL has been entrusted with the design of the prestressing gallery under the plant at Hinkley Point. The prestressing gallery is used for tensioning the cables of the EPR's inner containment wall. With no structural link to the slab, the prestressing gallery takes the form of a ring 26 m in diameter with a rectangular cross-section (height 3.5 metres). A ring of mass concrete is built around the gallery in order to limit the impact of the loads transmitted by the plant slab. The complexity of the geological context (general dip of the strata towards the north, anisotropy of the deformation moduli) lead to prepare three-dimensional numerical modelling using PLAXIS software (400,000 elements). A specially-developed routine in Visual Basic is intended to make the distribution of pressures (of static and/or seismic origin) under the slab produced by the structure model compatible with the PLAXIS model.



The model was then used as a tool to justify the structural strength of the gallery, optimise the geometry of the mass concrete around it, and define the optimal contact conditions to be guaranteed between the mass concrete and the gallery.

E. Cazes and F. Cuira



Foxta v3.1

Groupe+

This new Foxta v3 module has been in beta test for several weeks. It enables to calculate rigid slabs founded on piles. The piles and the soil layers can be defined freely (position and inclination). The new iterative calculation engine solves multiple load cases by direct processing of the various iterations necessary for obtaining the distribution of the loads in each pile, taking into account if required the soil plastification under lateral loading.

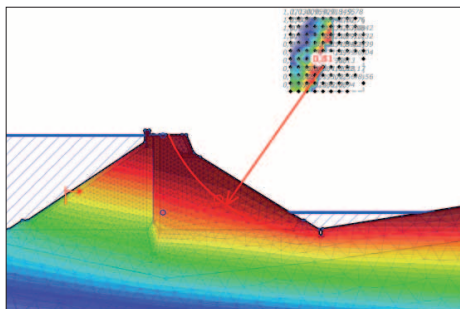
Talren v5

Talren v5, our software for slope stability analysis, will be updated soon. This update will allow you to apply incremental loading and to display shadings when you define or import a pore pressure mesh.

The next major step in Talren v5 will be the introduction of a new module for sensitivity analysis. More information will be available in the next edition of our letter.

Conferences

TERRASOL attended several conferences during the past months: 14th International Congress AFTES (October, France), 7th Greek Conference on Geotechnical Engineering (November, Greece), 2nd International Symposium on Railway Geotechnical Engineering GEORAIL (November, France), 4th Maghreb Conference for Geotechnical Engineering (November, Tunisia) and 3rd International Seminar on Innovation and Valorisation in Civil Engineering (November, Algeria).



Pressures mesh TALREN v5



GEORAIL Symposium - November 2014

F. David

Recent publications and presentations

- 2D and 3D numerical analysis for the design of a TBM dismantling cavern to be excavated under sensitive buildings for Paris metro line extension (**JP. Janin**, A. Martin and O. Gastebled) – NUMGE 2014 - Delft, June 2014
- Remblai expérimental sur inclusions rigides (L. Briançon, **B. Simon**, G. Auray) – JNGG 2014 - Beauvais, July 2014
- Validation d'un système de classification thermique des sols (**P. Reiffsteck**, M. Couaillier and G. Grandjean) – JNGG 2014 - Beauvais, July 2014
- Le modèle Kranz : enjeux conceptuels et considérations pratiques (**F. Cuira** and **B. Simon**) – JNGG 2014 - Beauvais, July 2014
- Une mise en œuvre pratique de l'analyse des risques en géotechniques (**E. Cazes**, **F. Cuira** and **B. Simon**) – JNGG 2014 - Beauvais, July 2014
- Les fondations profondes du pont sur la lagune à Abidjan (**B. Simon**, D. Michel, T. Perini and G. Kilidjian) – Revue Travaux 907, July 2014
- Remblai ferroviaire sur inclusions rigides (L. Briançon, **B. Simon**, M. Dupraz and G. Maubert) – Revue Travaux 907, July 2014
- South Toulon tube : 3D numerical back-analysis on in situ measurements (**JP. Janin**, **H. Le Bissonnais**, **A. Guilloux**, D. Dias, R. Kastner and F. Emeriault), 8th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, Seoul, August 2014
- Pile-supported embankment over soft soil for South Europe Atlantic high speed line (L. Briançon, **B. Simon** and G. Auray) – 10th International Conference on Geosynthetics – Berlin, September 2014
- Puits de reconnaissance et essais en vraie grandeur pour une nouvelle gare RER à La Défense (**J. Marlinge**, L. Canolle, O. Thuaud) – Congress AFTES 2014, October 2014
- Tunnel de Saverne (LGV Est) : Déroulement des études géologiques et géotechniques en phase conception et travaux dans le cadre d'un processus de maîtrise des risques (**H. Le Bissonnais**, P. Legrand, PL. Veyron, A. Lacroix and A. Cuccaroni), Congress AFTES 2014, October 2014
- Prise en compte des effets différés dans les ouvrages géotechniques enterrés (G. Tzimas, **H. Le Bissonnais** and R. Witasse), Congress AFTES 2014, October 2014
- Variabilité de résultats pressiométriques dans un sol argilo-sableux saturé (**A. Bergère**, **F. Asselborn**, **A. Guilloux**, E. Touboulie and C. Servant) – 2nd International Symposium on Railway Geotechnical Engineering, November 2014
- Maîtrise des déformations de la plateforme ferroviaire au droit des ouvrages d'art non courants (A. Cuccaroni, **P. Legrand**, S. Bernhard, G. Priol, PL. Veyron) – 2nd International Symposium on Railway Geotechnical Engineering, November 2014
- Centrifuge Modeling of a Pile-Supported Granular Earth-Platform (**US. Okyay**, D. Dias, L. Thorel and G. Rault) – ASCE, Journal of Geotechnical and Geoenvironmental Engineering, vol 140, 2014
- Apports de l'interaction sol-structure dans la conception des ouvrages (**F. Cuira**) / Comportement d'un réservoir enterré sous l'effet de variations de température (**F. Cuira**, **B. Simon**) – Sousse, November 2014
- Comment un choix éclairé des paramètres géotechniques contribue à une bonne conception des ouvrages (**B. Simon**) - 4^{ème} Conférence Maghrébine de Géotechnique - Sousse, November 2014
- Quelques exemples d'application du calcul à la rupture à des ouvrages géotechniques. (**B. Simon**) - 4^{ème} Conférence Maghrébine de Géotechnique - Sousse, November 2014
- Tunnel face reinforcement by bolting – Numerical modelling of centrifuge tests (**JP. Janin** and D. Dias), Soils and Rocks, vol 37, Sao Paulo, 2014



Scan this QR Code with your Smartphone

Head office

Immeuble Central Seine
42-52 quai de la Râpée
75583 Paris Cedex 12
France

Tel: +33 (0)1 82 51 52 00
Fax: +33 (0)1 82 51 52 99
Email: info@terrasol.com

Rhône-Alpes office

Immeuble le Crystallin
191/193 cours Lafayette
69458 Lyon Cedex 06
France

Tel: +33 (0)4 27 85 49 35
Fax: +33 (0)4 27 85 49 36
Email: lyon@terrasol.com

Terrasol Tunisia

2, rue Mustapha Abdesslem
El Menzech
2037 Tunis
Tunisia

Tel: +276 71 23 63 14
Fax: +256 71 75 32 88
Email: info@terrasol.com.tn