



Editorial

It is a great honour for me to succeed Alain GUILLOUX within the TERRASOL team, which has been able to position itself over the years as a reference engineering firm on the French geotechnical scene.

We now have all the assets that we need to continue our route on the same path and write the next pages of the exciting history of TERRASOL, started in 1979 by François SCHLOSSER: the experience of our experts allied with the dynamism of a young and multicultural team (we now total 60 staff, including nearly 50 geotechnical engineers), superb customer references we can rely on, a high capacity for listening to and dialoguing with our customers and partners, our willingness to accept the challenge of increasingly complex geotechnical projects, and a constant appetite for the development of new skills and for innovation in geotechnics, for example currently in the areas of soil dynamics (see opposite), geothermal foundations and risk analysis.

TERRASOL also has an already long international history: very early on, our engineers were called on for expertises abroad, and we now generate on average 25% of our annual turnover on projects beyond our borders (map on inner pages); today our ambition is to pursue the development of our international activities, whether for our direct customers or through SETEC group projects.

This new issue of the TERRASOL Newsletter illustrates some projects and topics which we dealt with during the first half of 2014, and introduces our new visual identity, which is part of a movement common to all the companies of the SETEC group, in France and internationally. This new visual identity is for us an opportunity to reaffirm our values, such as (geo)technical excellence and independence, whether we are working directly for our customers or as part of the multidisciplinary teams of the SETEC group. We will apply it gradually to all our media and documents.

All of us at TERRASOL are at your disposal, and wish you a great summer!

V. Bernhardt

Earthquake engineering and soil-structure interaction

Measures must be taken to minimise the material and human consequences of the threat constituted by the seismic risk. Above all, this preventive approach requires appropriate design of structures taking fully into consideration the dynamic character of seismic loads.

Until recently, earthquakes were taken into account in the design of geotechnical structures mainly through simplified pseudo-static models enabling to join up with common design practices. Today, the introduction of the Eurocodes and the recent awareness of the issues related to the seismic risk lead to favour computer models which are capable of realistic processing of the dynamic behaviour of the soil interacting with the structure that it supports. The development of these models, which demand a fresh and enlightened view by the engineer, is nevertheless hampered by a geotechnical corpus which is not familiar with seismic aspects and which by a wide margin prefers semi-empirical design based on the pressuremeter test data.

In this context, and thanks to the multidisciplinary training of its team, TERRASOL has developed advanced practice in design of earthquake-resistant structures.

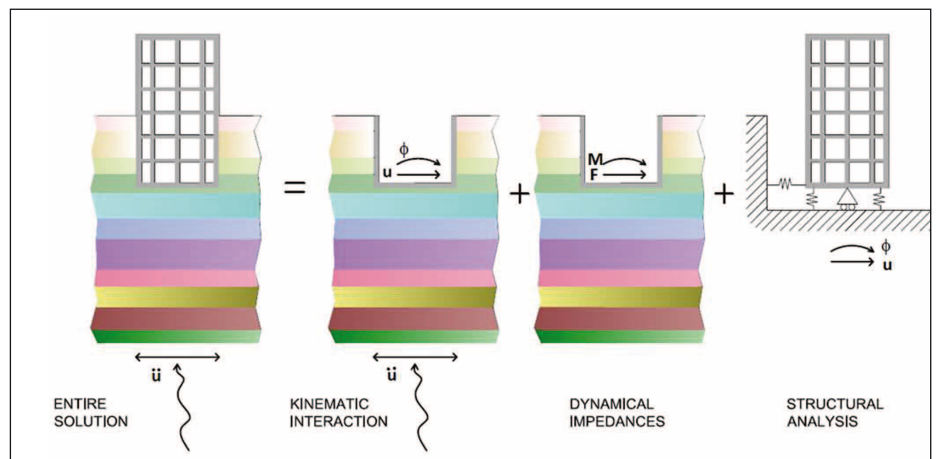


Credit: Alessandro Canella - Building after a seism in Italy, 2012

This requires effective control of soil-structure interaction effects going well beyond the radical simplification consisting in assuming the structure to be perfectly embedded at its base, a simplification sometimes leading to excessively unrealistic results.

In practice, this interaction may be analysed by representing the soil response using dynamic impedance functions (expressing the soil stiffness and damping according to the natural frequency content of the load) and, strictly speaking, by considering the seismic movement affected by the presence of the structure (kinematic interaction). This type of analysis, which can be performed easily using a SASSI or similar model, is regularly used for design of new or existing earthquake-resistant industrial facilities, in particular for EDF and AREVA.

F. Caira and B. Simon



Melamchi Water Supply Project

Nepal

This project is intended to provide a safe and effective drinking water supply in the Katmandu valley, to improve sanitary conditions there and thus to help the economic development of the valley. It includes a tunnel about 26 km long, three access tunnels (adits) and structures for diverting the river upstream of the valley.

The tunnel and the adits are excavated using explosives in the Precambrian massif of the Himalayan complex, characterised by rock formations with high metamorphism. The strata concerned by the tunnel excavation are the gneiss, quartzites and schists. The support selected by the Project Manager consists mainly of radial bolts and shotcrete. Steel arches are to be considered in the areas where the rock is most degraded.

Works began in April 2010 with a first contractor, but were suspended in September 2012. In June 2013 a new contract was signed with CMC (Cooperativa Muratori e Cementisti di Ravenna). CMC requested the engagement as consulting expert of Marc PANET, who asked TERRASOL to assist him in his on-site assessment in April 2014. The aims of this assessment were to analyse the structures already completed (a total of about 6 km of adits and part of the main tunnel) and to put forward recommendations for the completion of the sections still to be excavated.

The assessment concluded that the short-term stability of the completed tunnel sections was satisfactory. However, works must be scheduled to improve the existing tunnel support in order to ensure the long-term integrity of the structure. In particular, systematic checking of the thickness and the quality of the shotcrete was recommended. Other recommendations covered the management of the geological difficulties likely to be encountered during the remaining excavation, and the optimisation of the works cycle and of the support/lining to be installed.



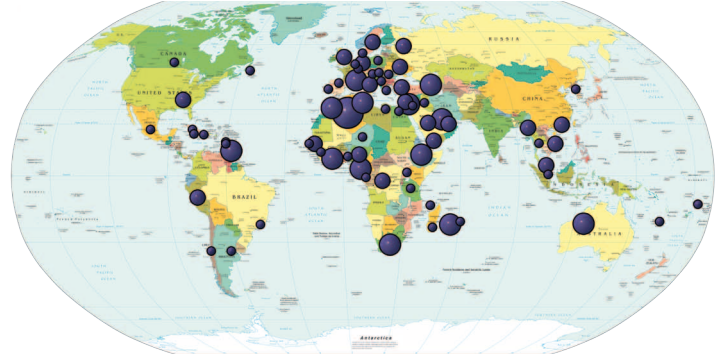
J.P. Janin

Terrasol and the African continent

Africa

In recent years, TERRASOL has been generating around 25% of its activity on projects in foreign countries, whether for French contractors, French companies in the energy sector, or directly for local or international customers, and whether on individual jobs or on long-term projects. The opposite map shows where we have worked since 2006. Africa features as one of our regions of predilection, and we have chosen in this issue to review the long history linking TERRASOL and the African continent.

Practically since its establishment, TERRASOL has worked in Africa for expertises on landmark projects that have greatly contributed to the development of this part of the world, from the Trans-Gabon railway to phosphate mines in Tunisia via motorways in Morocco.



Bouregreg bridge

Over the last ten years or so we have increased our local presence: establishment of TERRASOL Tunisia, continued presence in Algeria, collaboration with SETEC group companies in Morocco and Senegal, regular assignments for French contractors everywhere in Africa.

Our key word at the moment is diversification. In addition to our expertises all over the continent and our participation in many civil engineering projects for roads and related structures (East-West motorway in Algeria for CRCC, Corniche Road in Brazzaville with SETEC TPI and SGI, bridge over the Gambia river with SETEC TPI and STUDI, Bouregreg bridge in Morocco with SETEC TPI, Riviera Marcory bridge for BOUYGUES TP in Ivory Coast, etc), we have also worked recently in these areas:

- transport: railway projects in Algeria and in South Africa,
- energy: wind turbine farm in Ethiopia, oil and gas tanks in Tunisia, thermal power plants in Ivory Coast, Tunisia, Morocco, South Africa and other countries,
- port facilities: harbour in Equatorial Guinea.

Africa is nowadays undergoing rapid development and clearly has substantial potential. TERRASOL intends to build on its experience in Africa and its knowledge of the local market to further strengthen its presence on the continent over the coming years, as part of the overall development of its international activities.

J. Drivet, V. Bernhardt

Saint-Béat tunnel

Haute-Garonne, France

The upgrading of the RN 125 main road between Saint-Béat and Arlos in the French Pyrenees will enable to bypass the village of Saint-Béat by means of a tunnel through the Cap de Mount mountain. The village is renowned for its quarrying of white marble, the formation constituting most of the massif through which the tunnel is built.

The GUINTOLI – SOLÉTANCHE-BACHY – SOLÉTANCHE-BACHY TUNNELS – PIZZAROTTI consortium has contracted TERRASOL and BMCI (a subsidiary of SETEC TPI) for the geotechnical and civil engineering detailed design of the tunnel. The 1018-metre-long tunnel was excavated by the traditional method using explosives, with a support mainly comprising bolts and shotcrete. Despite a geology favourable to tunnelling (Marmorean limestone and good-quality marble, with limited fracturing), the works gave rise to some surprises: karsts at the northern portal, and substantial water inflow at the southern face. The main difficulty of the project, clearly identified by the first explorations, was the interception by the northern safety tunnel of a glacial furrow filled with alluvial materials. The analysis of additional explorations from the tunnel and from the surface resulted in the proposal to cross this geological irregularity by means of an arched support reinforced by forepoling. The excavation of the main tunnel was completed in December 2013.



H. Le Bissonnais

Oil & Gas complex

Das Island (Abu Dhabi, United Arab Emirates)

ADNOC is one of the largest national oil companies and one of the most advanced in terms of seismic analysis and recovery optimisation techniques applied to its oil fields, both onshore and offshore. Its subsidiary Abu Dhabi Gas (ADGAS), specialising in the processing, marketing and distribution of LPG and LNG, has contracted CEGELEC OIL AND GAS for the construction of an eighth turbine (36 MW, Frame 6 type) on Das Island, which is located in the Persian Gulf about 110 km from the Emirate of Abu Dhabi.

In the framework of civil engineering studies, CEGELEC contracted TERRASOL for the geotechnical detailed design.

TERRASOL first worked on the definition and supervision of the on-site geotechnical investigations, in strict compliance with offshore safety and risk management procedures. We then designed the foundations of the various elements of the power plant (turbine, structural steelwork, chimney, buildings, etc), paying particular attention to the behaviour of the deep foundations under dynamic loading.



C. Bernuy

Photo credit: Cegelec

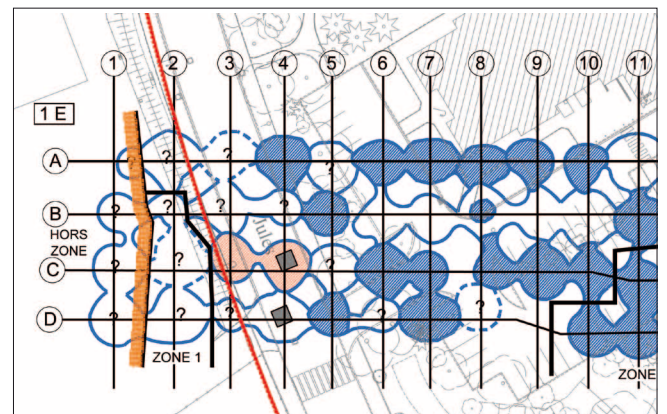
Backfilling 'catiches' in Lille

Nord region, France

In Lille as in Paris, urban expansion has reached the fields of 'catiches', bottle-shaped traditional underground quarries (200 to 350 m³ in general) grouped in bunches.

These catiches present risks of subsidence at the heart of the Lille conurbation. TERRASOL was involved within the framework of the overall project management of the redevelopment of the southern districts to deal with this problem:

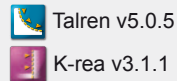
- Preliminary phase: identification and updating of the location (layout) of the 260 catiches listed in the area (summary of existing data, definition and supervision of additional explorations, condition of each catiche – empty or partly backfilled);
- Project phase: definition of the primary treatment (elimination of potential subsidence by backfilling with economical run material, by tipping or drilling) and, if necessary, of the secondary treatment (control of settlement under vulnerable roads and utilities by installing a reinforced concrete slab or grouting);
- Works phase: definition of the operation stages taking the complex urban context into account and adjusting the grouting cycle in order to manage the quantities injected (payment by the quantities according to the contract).



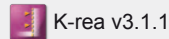
Works were completed in autumn 2013, and the assessment is positive: the improvement principles were validated and, although individually the treatment of most of the catiches differed from the initial estimate, the contract quantities were globally complied with.

F. Binet

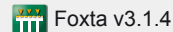
Software Department



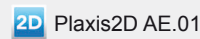
Talren v5.0.5



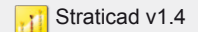
K-rea v3.1.1



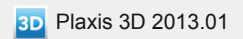
Foxta v3.1.4



Plaxis2D AE.01



Stratcad v1.4

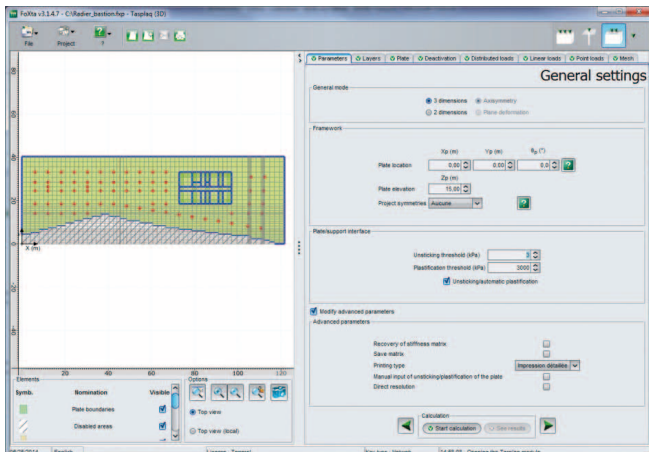


Plaxis 3D 2013.01

Foxta v3



The English version of Foxta v3 is now available! Foxta is a powerful and easy-to-use software suite dedicated to foundations design. This software will help you model quickly and efficiently any type of foundations: shallow or deep foundations, piled-raft foundations, stiff inclusions, pile groups, several adjacent rafts, etc. It includes 8 different modules, which may be used as standalone programs, or alternatively combined for advanced calculations.



Foxta v3 - Tasplaq module

K-Réa v3.1



This new update maybe downloaded (for free) on our website for present users of K-Rea v3: it includes an upgraded version of the user-interface, which is fully compatible with the latest Windows® versions.

Agent focus on Viziterv (Hungary)

We are happy to introduce Viziterv as our new software agent for Hungary!

Viziterv is a company of the SETEC group based in Hungary: their main activity is water engineering, and they also develop their geotechnical engineering services.



We jointly organized a presentation of TERRASOL software on June 19th, 2014, in Viziterv offices: 20 participants from Győr University and various Hungarian companies attended this event.

Feel free to contact them for information or a demo:
www.viziterv.hu / titkarsag@viziterv.hu



Viziterv's team

F. David

Recent publications and presentations

RSS 2014 Rock Slope Stability – Marrakech, April 2014

- « Stabilité de pentes en sols indurés et roches tendres » (**A. Guilloux**)
- « Déviation de la RD1091 au droit des Ruines de Séchillienne : évolution du dimensionnement d'un grand déblai rocheux dans un site géologiquement complexe » (**Jean Drivet** and **Anthony Bachelier**)

NUMGE 2014 - Delft, June 2014

- 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**)

International Workshop – Maritime & Port Engineering, ESITC Caen, June 1st to 30th, 2014:

- Cécile Babin** and **Bruno Simon** contributed to this workshop which was attended by students from 12 different nationalities, in the framework of a curriculum common to their universities and to ESITC. Their one-day presentation focused on the design of dykes submitted to tide, and on the use of Talren software.



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