Son Doong Cave, Vietnam

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

85

Αρ. 85 – ΔΕΚΕΜΒΡΙΟΣ 2015

SIMSG ISSMGE

ISRM

Τρίτη, 15 Μαρτίου 2016, ώρα 10:00 ÷ 17:00
Αμφιθέατρο του Υπουργείου Εξωτερικών

Ημερίδα

Εξαγωγή Τεχνογνωσίας από Έλληνες Πολιτικούς Μηχανικούς

Σύλλογος Πολιτικών Μηχανικών Ελλάδος σε συνεργασία με το Τεχνικό Επιμελητήριο Ελλάδος & το Hellenic Section της American Society of Civil Engineer

---

Πέμπτη, 17 Μαρτίου 2016, ώρα 5:30-9 μ.μ.
Αίθουσα Πολυμέσων, Κτίριο Βιβλιοθήκης ΕΜΠ, Πολυτεχνειούπολη Ζωγράφου

Εσπερίδα

Γεωτεχνικά Θέματα Υποδομών Παραγωγής & Μεταφοράς Ενέργειας

Εργαστήριο Εδαφομηχανικής, Σχολή Πολιτικών Μηχανικών Εθνικού Μετσοβίου Πολυτεχνείου

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

ΠΡΟΣΕΧΕΙΣ ΕΚΔΗΛΩΣΕΙΣ ΓΕΩΤΕΧΝΙΚΟΥ ΕΝΔΙΑΦΕΡΟΝΤΟΣ ΣΤΗΝ ΕΛΛΑΔΑ

Εξαγωγή Τεχνογνωσίας από Έλληνες Πολιτικούς Μηχανικούς

Την Τρίτη 15.03.2016 θα διεξαχθεί στο αμφιθέατρο του Υπουργείου Εξωτερικών (10:00 ÷ 17:00) ημερίδα με θέμα **«Εξαγωγή Τεχνογνωσίας από Έλληνες Πολιτικούς Μηχανικούς»**. Η ημερίδα διοργανώνεται από τον Σύλλογο Πολιτικών Μηχανικών Ελλάδος σε συνεργασία με το Τεχνικό Επιμελητήριο Ελλάδος και το Hellenic Section της American Society of Civil Engineers.

Η εκδήλωση αποτελεί την πρώτη δράση σχεδίου προώθησης των εξαγωγών υπηρεσιών Πολιτικού Μηχανικού και έχει τεθεί υπό την αιγίδα του Υπουργείου Εξωτερικών.

https://www.youtube.com/watch?v=odobDwBgEVY

ଓ ଛ

ΕΘΝΙΚΟ ΜΕΤΣΟΒΙΟ ΠΟΛΥΤΕΧΝΕΙΟ
ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΡΓΑΣΤΗΡΙΟ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ

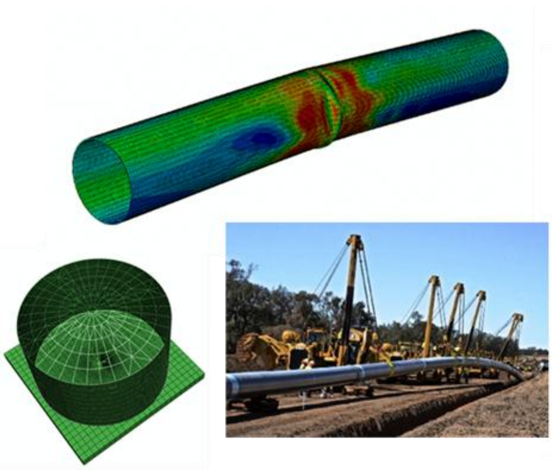
ΕΣΠΕΡΙΔΑ

Γεωτεχνικά Θέματα Υποδομών Παραγωγής & Μεταφοράς Ενέργειας

Πέμπτη, 17 Μαρτίου 2016, ώρα: 5:30-9 μ.μ.

Αίθουσα Πολυμέσων, Κτίριο Βιβλιοθήκης ΕΜΠ, Πολυτεχνειούπολη Ζωγράφου

Μεταφορά, Αποθήκευση Υδρογονανθράκων



- Κατολισθήσεις και Υπόγειοι Αγωγοί
- Σεισμική Ανάλυση Δεξαμενών
- Πειραματική Διερεύνηση Αλληλεπίδρασης Αγωγού-Εδάφους
- Απλοποιημένη Μεθοδολογία
- Υποθαλάσσιοι Αγωγοί

Θαλάσσιες Ανεμογεννήτριες, Πλατφόρμες Πετρελαίου

- Ανεμογεννήτριες σε Μονοπασσάλους
- Εναλλακτικά Συστήματα: Κοίλα Κυλινδρικά Φρέατα (Suction Caissons)
- Ανάλυση: Ανακυκλική + Σεισμική Φόρτιση
- Θεμελίωση Θαλάσσιων Πλατφορμών Άντλησης Πετρελαίου: Αριθμητική Ανάλυση

Γ. Γκαζέτας
Δ/ντής Εργαστηρίου Εδαφομηχανικής

Δήλωση συμμετοχής soildyn_ntua@outlook.com

ଓ ଛ

GREEK TUNNELLING SOCIETY YOUNG MEMBERS GROUP — HERRENKNECHT Tunnelling Systems

Η Ελληνική Επιτροπή Σηράγγων και Υπογείων Έργων (Ε.Ε.Σ.Υ.Ε.) και η Ομάδα Νέων Μελών σας προσκαλούν στο Σεμινάριο - Εσπερίδα περί

Μηχανών Ολομέτωπης Κοπής Σηράγγων (TBM)

που θα πραγματοποιηθεί από την Herrenknecht AG την **Παρασκευή 18 Μαρτίου 2016**, ώρα 14.00-19.00, στο Royal Olympic Hotel* με βασική θεματολογία:

Session 1 – Types and Operations

- Introduction – History
- TBM Types
- TBM Logistics

- TBM Operations (Excavation, Grouting, Segmental Lining, Face Intervention, Monitoring

Session 2 - Gotthard Base Tunnel

- Study of risks & contingencies to overcome problems

Session 3 – Case Studies

- Metro, Road and Hydropower Projects

Session 4 – Mega TBMs

- Review, Problems and Future Trends

Η συμμετοχή στην ημερίδα είναι δωρεάν και είναι απαραίτητη η εγγραφή σας στον παρακάτω σύνδεσμο:

http://goo.gl/forms/Fvr4SrZMTc

Θα τηρηθεί η σειρά προτεραιότητας λόγω περιορισμένων θέσεων.

Για διευκρινίσεις μπορείτε να απευθυνθείτε στην ηλεκτρονική διεύθυνση: ymg.gts@gmail.com

*Royal Olympic Hotel - Αθανασίου Διάκου 28-34, Αθήνα, 117 43

ΑΡΘΡΑ

Παρουσίαση άρθρων, στην συγγραφή των οποίων μετείχαν Έλληνες, στο XVI European Conference on Soil Mechanics and Geotechnical Engineering, Edinburgh, 13-17 September 2015 (κατ' αλφαβητική σειρά, στα ελληνικά, του ονόματος του πρώτου συγγραφέα).

Nonlinear analyses of soil amplification in the MJMA8, 2003 Tokachi-Oki earthquake

Analyse Non Linéaire des l' Amplification des Sols pendant le Tremblement de Terre de Tokachi-Oki (MJMA8, 2003)

E. Garini, G. Tsinidis, E. Riga, S. Karapetrou, A. Karatzetzou, S. Fotopoulou, G. Gazetas and K. Pitilakis

ABSTRACT Earthquake case histories of soil response over the last 70 years reveal the strongly non-linear hysteretic behaviour of soils. Over the years, numerous efforts have been made to represent more realistically soil response in the strongly nonlinear range. The paper studies three particular sites in the Hokkaido island during the MJMA8.0, 26 September 2003 Tochachi-Oki earthquake. Borehole accelerometers installed on the surface and the "bedrock" of these sites, provided a complete set of data. We subjected the profiles to the acceleration time histories recorded at their base. Numerical simulations are performed using research and commercially available codes: NL-DYAS, DEEPSOIL, ABAQUS, OPENSEES, incorporating several constitutive models. Numerical results for acceleration time histories and response spectra are systematically compared with those of the recorded motion.

RÉSUMÉ Le comportment sismique des sols au cours des séismes et des observations faites les 70 dernières années, rélève l'importance de son comportement non linéaire et hystérétique. Au fil des années, de nombreux efforts ont été déployés pour représenter de façon réaliste la réponse du sol dans des conditions fortement non linéaires. Dans ce cadre le travail présenté ci-joint exploit la modélisation non linéaire de quatre sites particuliers dans l'ile de Hokkaido au Japon pendant le tremblement de terre de Tochachi-Oki (MJMA8.0, 26 Septembre 2003). .Le choix des ces sites est faite a cause des donnes accelerometriques de bonnes qualité, disponibles aussi bien en surface et en profondeur sur le substratum rocheux. Des simulations numériques de la réponse des sols sont effectués avec des enregistrements reels au bedrock, utilisant les codes NL-DYAS, DEEPSOIL, ABAQUS et OPENSEES, qui intègrent plusieurs types des modèles constitutifs. Les resultants acquis sont compares avec les enregistrements réels en surface ainsi que entre eux. Le but de cette étude comparative est l'analyse de l'efficacité des ces codes de calcul de la réponse des sols en régime linéaire et non linéaire.

1 INTRODUCTION-SCOPE OF STUDY

The influence of local soil conditions on the intensity and frequency content of earthquake ground motions has been extensively studied over the years. A particular surface recording reflects to some degree the characteristics of the near-surface soil layers at the recording site. Numerous vertical seismic arrays that have recorded strong earthquake shaking are quite helpful in resolving past controversies regarding the importance of local soil conditions and the analytical methods to determine surface soil response.

The objective of this study is to present an evaluation of 1-D soil-amplification theories in light of recorded motions at three sites on the Hokkaido Island during the 2003 Tokachi-Oki earthquake in Japan.

2 THE M_{JMA}8.0 TOKATCHI-OKI EARTHQUAKE: GROUND MOTION RECORDS AND SOIL PROFILES

A severe earthquake struck Hokkaido, Japan, on September 26, 2003. The epicenter was about 80 km east-southeast of Erimo Cape, offshore of Tokachi (Figure 1). The depth of its hypocenter was about 40 km, and its magnitude 8.0 in the JMA-scale. The main event was followed by a M 7.1 earthquake, and the affected area was 400 km long along the coast of Hokkaido Island. Despite the large magnitude and high PGA levels, the observed ground failure, liquefaction, and structural, port, and lifeline damage were remarkably small because the location was offshore. The earthquake was the third magnitude 8.0+ to strike the southeastern portion of Hokkaido in the last 50 years.

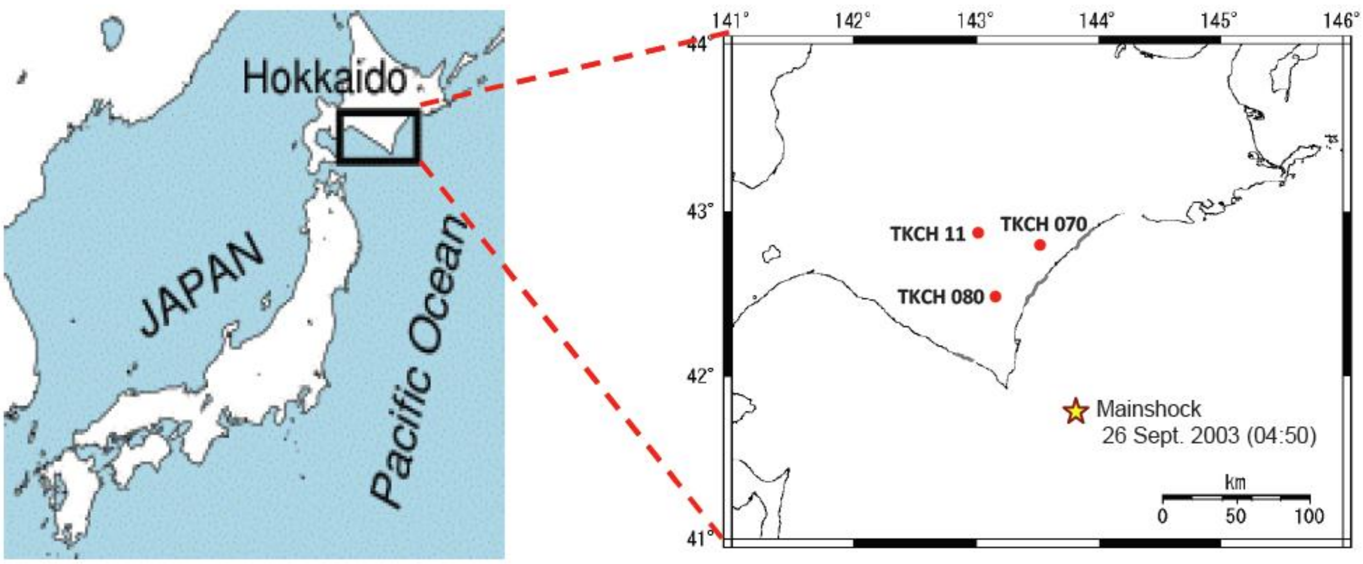


Figure 1. General map of Japan and the Hokkaido region, showing the epicenter of the earthquake and the three particular recording stations addressed in this paper.

The 2003 Tokachi-Oki M8.0 event was a megathrust earthquake resulting from segmented rupture of the Pacific plate beneath the Hokkaido-Tohoku, and more significantly it was the first large interpolate earthquake to be recorded by the nationwide strong motion networks, K-NET and Kik-Net. A large number of strong-motion, high sensitivity, and broadband accelerographs has been installed in a dense and fairly uniform network covering the whole Japan. The network of stations with an uphole/downhole pair of strong-motion seismographs is called KiK-Net, while a supplementary network consisting of 1034 strongmotion seismographs installed at the ground surface (K-Net).

Three of the recording sites in the island of Hokkaido that have provided pairs of records with relative large acceleration at the base "rock" and the surface are analysed here. They are denoted as TKCH 070, TKCH 080, TKCH 11 stations. Figure 1 shows their location while Figures 2-4 present the S-wave velocity profiles and the recorded accelerograms on the surface and at 100 m depth. Even before any analysis, the much greater accelerations on the surface are evidence of strong soil effects.

3 SOIL AMPLIFICATION RESPONSE

Inelastic one-dimensional wave-propagation analysis was performed for each of the aforementioned three profiles. The assumptions of one–dimensional analysis are that all soil layers are horizontal and that the response of a soil deposit is predominantly caused by S–waves propagating

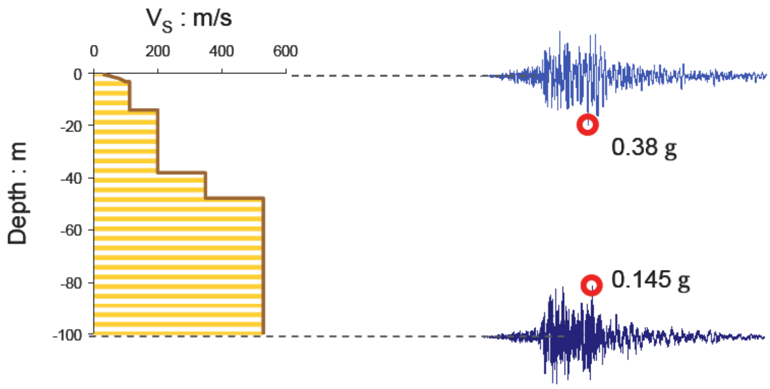


Figure 2. Soil profile at station TKCH 070. The distribution of V_s (m/s) with depth and the surface and bedrock recordings are also presented.

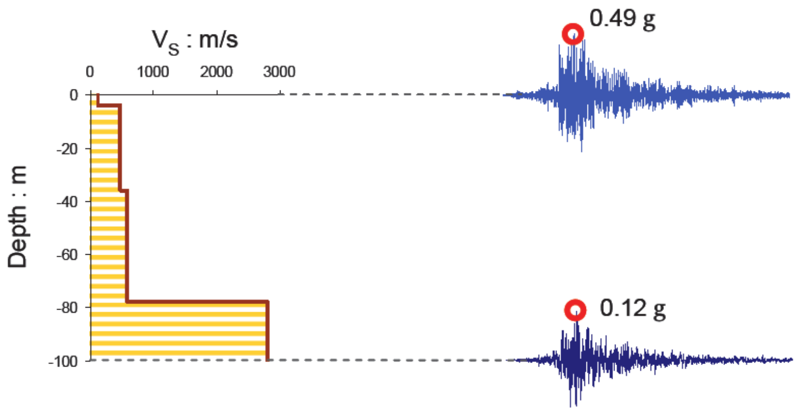


Figure 3. Soil profile at station TKCH 080. The distribution of V_s (m/s) with depth and the surface and bedrock recordings are also presented.

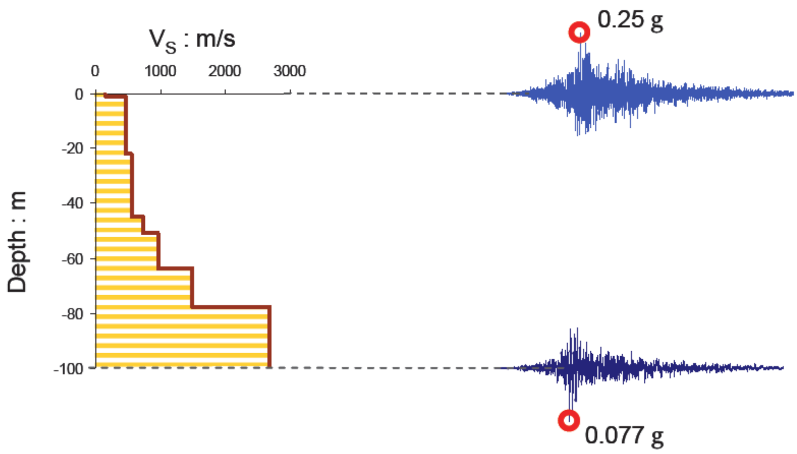


Figure 4. Soil profile at station TKCH 11. The distribution of V_s (m/s) with depth and the surface and bedrock recordings are also presented.

vertically from the underlying bedrock. Therefore, the soil and bedrock surface are assumed to extend infinitely in the horizontal direction.

Direct numerical integration in time domain is employed to analyse the nonlinear soil response. By integrating the equation of motion in small time steps, any stress-strain (constitutive) model can be used. Several researchers have proposed nonlinear hysteretic models of the soil behavior, and a number of techniques are available to integrate the equations of motion.

In our analyses, four different commercial and research numerical codes are employed, namely: ABAQUS (ABAQUS, 2012), OPENSEES (Mazzoni et al., 2009), DEEPSOIL (Hashash and Park 2001, 2002; Park and Hashash 2004) and NL-DYAS (Gerolymos and Gazetas, 2005, Drosos et al., 2012). ABAQUS and OPENSEES are generic finite element codes, while DEEPSOIL and NL-DYAS are specialised soil response analysis programs. All codes will be examined for the simplest case of 1D shaking, even if some of these codes (e.g. OPENSEES, ABAQUS) are capable of performing multi-dimensional earthquake loading ground response analyses.

NL-DYAS uses the smooth hysteresis model originally proposed by Bouc 1971 and Wen 1976, which was later extended by Gerolymos and Gazetas (2005) and Drosos et al. (2012).

A kinematic hardening model combined with a Von-Mises failure criterion and an associated plastic flow rule is used to model soil non-linear response under ground shaking in ABAQUS (Anastasopoulos et al., 2011). The analyses are performed with an implicit algorithm scheme, using full Rayleigh viscous damping formulation and Masing rules for unloading/reloading hysteresis.

Full Rayleigh viscous damping as well as Masing criteria, are also used in OPENSEES. Moreover, a multi-yield surface plasticity model with an associative flow rule is employed as described in Ragheb, 1994, Parra, 1996, Yang, 2000.

In DEEPSOIL the embedded MRDF pressuredependent hyperbolic model with non-Masing criteria is employed. DEEPSOIL provides a frequency independent damping formulation, as well as three types of Rayleigh damping (simplified, full and extended, with one, two and four modes needed to define viscous damping, respectively). The recommended frequency independent damping formulation was used for the analyses.

Only a summary of our results is presented below, aimed at showing the capabilities and limitations of the available in the profession numerical tools.

3.1 Inelastic Analyses

Figure 5 portrays the computed and recorded acceleration time histories at the surface of TKCH 080 station. The actual accelerogram recorded in the "rock" base at -100 m was the excitation in the analyses. Although it is difficult to discern in these figures, it appears that NL-DYAS and DEEPSOIL result in similar acceleration amplitudes, while ABAQUS and OPENSEES result in somewhat smaller amplitudes. This implies that the hysteretic damping is overpredicted by the soil models in ABAQUS and OPENSEES. However, all four codes result in similar response in terms of frequency content.

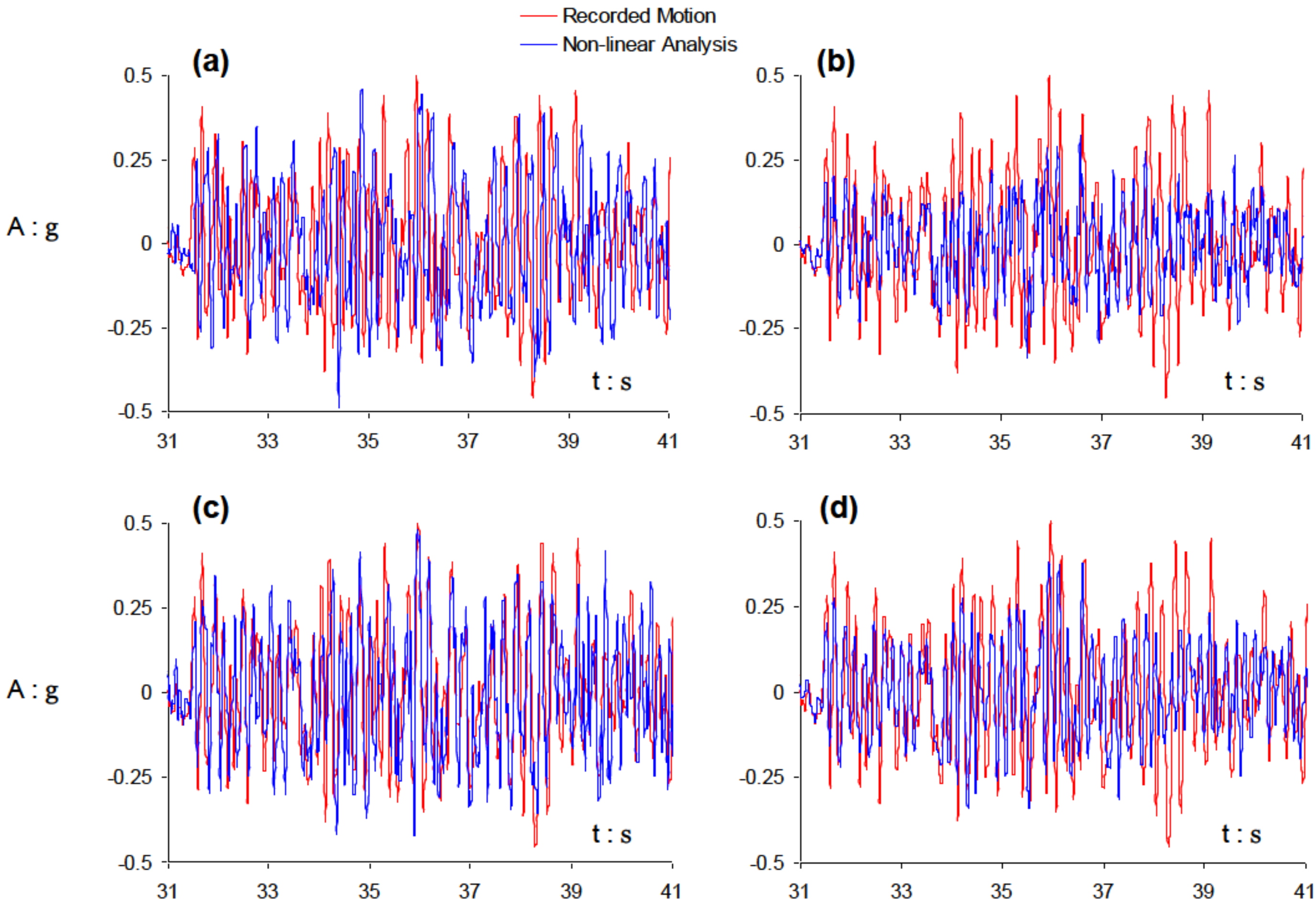


Figure 5. Acceleration time histories at the surface of station TKCH 080. The blue line is for the non-linear numerical analysis; the red for the record. Results by: **(a)** NL-DYAS, **(b)** ABAQUS, **(c)** DEEPSOIL, and **(d)** OPENSEES codes.

Figures 6, 7, and 8 compare recorded and computed inelastic response acceleration spectra for the TKCH 080, 11 and 070 respectively. In all these figures, the solid red line is the spectrum of the recorded motion, while all the other lines respond to the inelastic analyses spectra given by the four different codes. The following conclusions are drawn:

(a) All four numerical simulations lead to similar spectra.

(b) The best agreement between computed and recorded spectrum are for the station TKCH 080 (Figure 6). DEEPSOIL and NL-DYAS give the best agreement. Note that, TKCH 080 soil profile is one of the simplest, consisting of 78 m of gravel lying on very stiff sandstone (V_s = 2800 m/s). The recorded motion (-100 m) was imposed directly under the pebbles assuming that it should have not been modified by the sandstone.

(c) The computed spectra for TKCH 11 station, presented in Figure 7, are in a reasonably good, but hardly excellent, agreement with the target spectrum. Specifically, the computed spectra underestimate real response at the period ranges of [0.2 s, 0.3 s] and [0.6 s, 0.9 s].

(d) Record and analyses do not match at all in the case of TKCH 070 station (Figure 8). None of the models computes the high spectral accelerations between 0.6 and 1.6 seconds (which exceeds 1 g). The causes of this poor comparison have not yet been identified. Our suspicion: inappropriate soil profile.

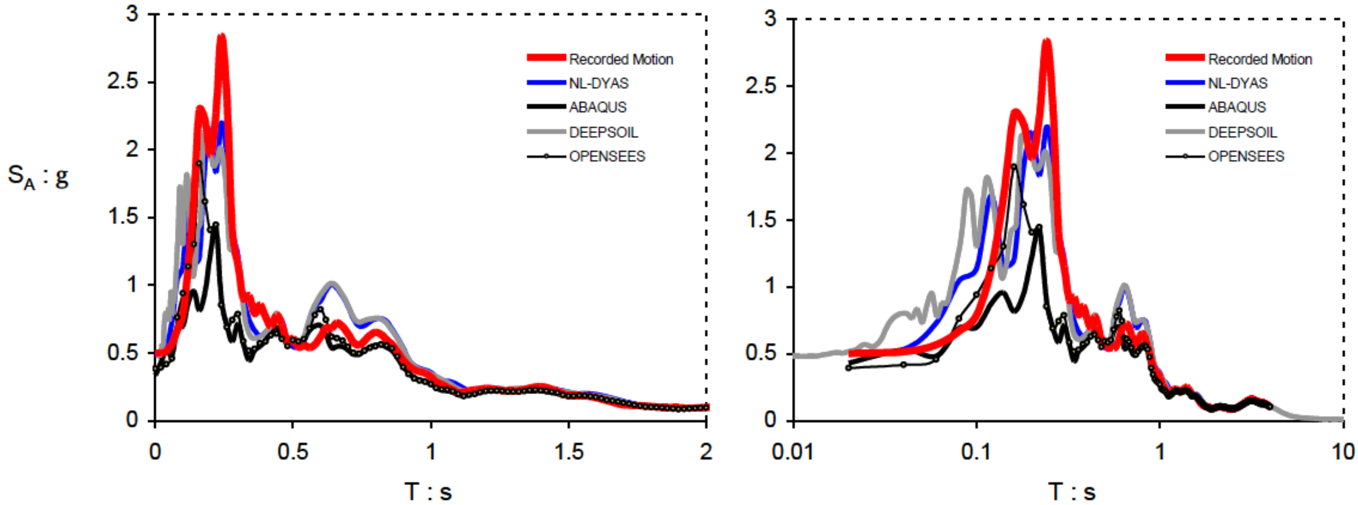


Figure 6. Comparison of response spectra in natural (left) and logarithmic (right) scales for station TKCH 080.

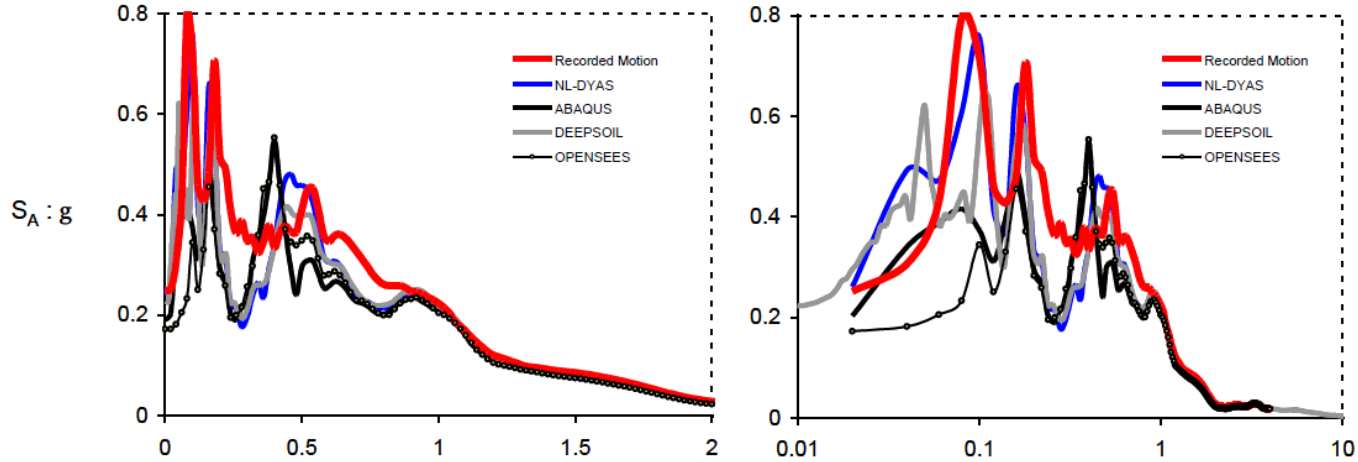


Figure 7. Comparison of response spectra in natural (left) and logarithmic (right) scales for station TKCH 11.

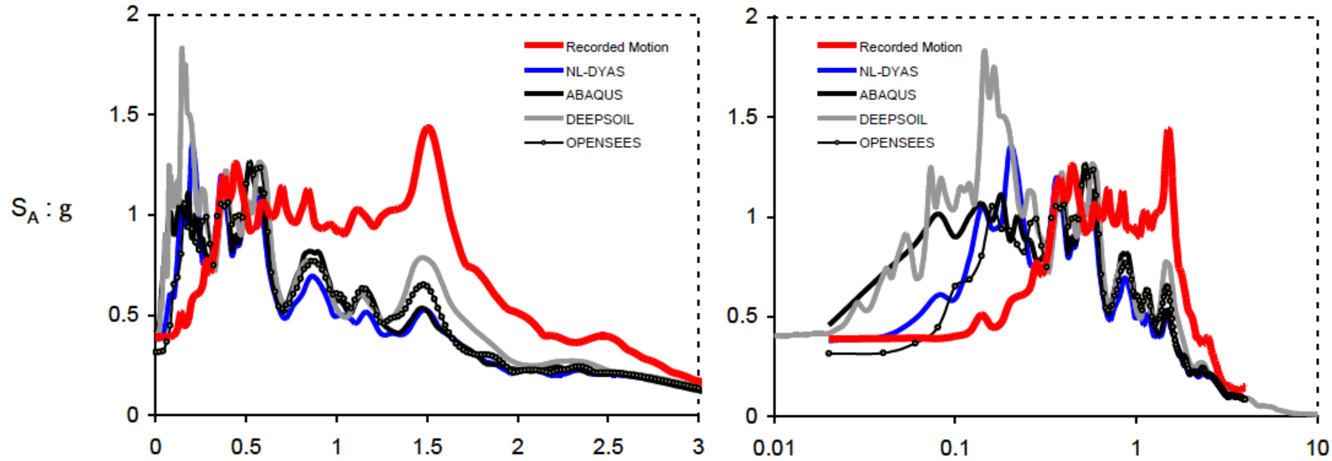


Figure 8. Comparison of response spectra in natural (left) and logarithmic (right) scales for station TKCH 070.

4 COMPARISONS AND CONCLUSION

The paper studied the fully non-linear response of three real soil profiles located in the Hokkaido island. The numerical simulations were performed with NLDYAS, DEEPSOIL, OPENSEES and ABAQUS codes. Results are presented in terms of acceleration time histories and their response spectra. For the TKCH 080 and TKCH 11 stations analyses, all four codes predict quite similar responses successfully approximating the actual recorded response at the ground surface. Mismatch problems were detected only for the case of the TKCH 070 profile. The reason could be attributed to inaccurate soil Vs profile, demonstrating the practical difficulties in making real-life design predictions of ground shaking.

ACKNOWLEDGEMENT

The research of E. Garini for this paper has been partially financed through the ARISTEIA IKY-SIEMENS program of the State Scholarships Foundation of Greece.

REFERENCES

ABAQUS, 2012. Theory and analysis user’s manual version 6.1 , Providence, RI, USA: Dassault Systèmes SIMULIA Corp.

Anastasopoulos, I. Gelagoti, F. Kourkoulis, R. & Gazetas, G. 2011. Simplified constitutive model for simulation of cyclic response of shallow foundations: validation against laboratory tests, *J Geotech Geoenviron Eng* **137**(12),1154–1168

Bouc, R. 1971. Modèle mathématique d'hystérésis: application aux systèmes à un degré de liberté, *Acustica* **24**, 16–25.

Drosos, V.A. Gerolymos, N. & Gazetas, G. 2012. Constitutive model for soil amplification of ground shaking: Parameter calibration, comparisons, validation, *Soil Dynamics and Earthquake Engineering* **42**, 255-274.

Gerolymos, N. & Gazetas, G. 2005. Constitutive model for 1-D cyclic soil behaviour applied to seismic analysis of layered deposits, *Soils and foundations* **45**(3), 147-159.

Hashash, Y.M.A. Groholski, D.R. Phillips, C.A. Park, D. & Musgrove, M. 2012. DEEPSOIL 5.1, User Manual and Tutorial.

Karatzetzou, A. Fotopoulou, S. Riga, E. Karapetrou, S. Tsinidis, G., Garini, E., Pitilakis, K., Gerolymos, N. & Gazetas, G. 2014. A comparative study of elastic and nonlinear soil response analysis, Proc. of 2nd ECEES, Istanbul August 25-29, Turkey.

Mazzoni, S. McKenna, F. Scott, M.H. & Fenves, G.L. 2009. Open System for Earthquake Engineering Simulation User Command-Language Manual, PEER, Berkeley, California.

Park, D. & Hashash, Y.M.A. 2004. Soil damping formulation in nonlinear time domain site response analysis, *Journal of Earthquake Engineering* **8**(2), 249-274.

Tazoh, T. Sato, M. Shimizu, K. & Hatakeyama, A. 1988. Nonlinear seismic response analysis of horizontally layered soil deposits, Proc. of 9th WCEE, Tokyo-Kyoto, Japan, Vol.II, 495-500.

Tazoh, T. Sato, M. Shimizu, K. & Hatakeyama, A. 1988. Nonlinear seismic response analysis of soil deposit using strong seismic records, Proc. of 9th WCEE, Tokyo-Kyoto, Japan, Vol.II, 507-512.

Wen, Y. K. 1976. Method for random vibration of hysteretic systems, *Journal of Engineering Mechanics* **102** (2), 249–263.

Ziotopoulou, A. & Gazetas, G. 2008. Tokachi–oki 2003: 1-D soil amplification studies with the Hokkaido base and surface records”, Research Report, NTUA, Zografou, Greece.

The use of slope stabilising piles and soil nailing to stabilise part of a large landslide complex at Lyme Regis, UK

Utilisation de pieux et sol cloué pour stabiliser une partie d'un grand complexe d'éboulement à Lyme Regis, R-U

D. G. Daskalopoulos

ABSTRACT The historic town of Lyme Regis lies on the Jurassic coast of southern England, a World Heritage Site. Part of the town and the coastal land immediately to its east lie within a major landslide complex with a long history of movement. The latest phase of stabilizing works includes a new seawall, an anchored pile retaining wall, slope stabilising piles, soil nailing, and drainage measures such as trench drains and sub-horizontal drilled drains. The scope of works area is subject to severe constraints related to its natural beauty, tourist trade and the World Heritage status. It is recognised that complete stabilisation of the landslide complex is not practicable, especially within these constraints and the works were aimed at preventing the extension of the landslide into the residential area of Lyme Regis. This paper outlines the geological setting of the site including the stratigraphy, groundwater conditions and landslide failure mechanisms along with the ground models and failure models developed from previous and specific ground investigations and published work. It goes on to describe the design of the slope stabilising piles and soil nailing and the way in which they work together to stabilise various identified and potential failures affecting the area known locally as the East Cliff. The paper describes the design details required to accommodate the constraints and some of the issues that affect construction on coastal cliffs within an active landslide complex.

RÉSUMÉ La ville historique de Lyme Regis se trouve sur la côte jurassique au sud de l'Angleterre, site de patrimoine mondial. Une partie de la ville ainsi que la côte située à l'est de la ville se trouvent au-dessus d'un important éboulement avec une longue histoire de mouvement. La dernière phase des travaux stabilisants inclut une nouvelle digue, un mur de soutènement en pieux ancrés, des pieux pour la stabilisation du versant, du clouage de sol, et des tranchées drainantes et drains forés subhorizontaux. La portée de la zone de manoeuvre est sujette à des contraintes très strictes liées à la beauté naturelle de la région, le commerce touristique et au statut de patrimoine mondial. Il est bien reconnu q'une complete stabilisation de l'éboulement n'est pas faisable, particulièrement lorsqu'on tient compte des contraintes imposées, et les travaux visaient principalement à empêcher l'extension de l'éboulement vers la zone résidentielle de Lyme Regis. Cet article décrit le contexte géologique du site comprenant la stratigraphie, le régime des nappes souterraines, et les mécanismes d'échec d'éboulement avec des lois de comportement du sol et des modèles d'échec développés à partir d' études géotechniques précédentes spécifiques au site et à partir de bibliographie publiées. L'article introduit egalement la conception de pieux stabilisant la pente et le clouage du sol, ainsi que la manière dont ils fonctionnent ensemble pour stabiliser divers échecs identifiés et potentiels affectant le secteur connu localement comme la Falaise Est. Enfin, l'article décrit les détails de conception requis pour s'adapter aux contraintes et à certains elements qui affectent la construction sur les falaises côtières dans le cadre d'un éboulement actif.

1 INTRODUCTION

As part of the Lyme Regis Environmental Improvements Phase IV, the stability of a section of the foreshore, known as East Cliff, was improved by utilizing a combination of slope stabilising (dowel) piles and soil nails.

Due to restrictions on plant weight and working space, a single stabilisation measure could not be adopted. The relatively low maximum plant weight considered safe to operate on the foreshore slopes (4 tonnes) resulted in a maximum pile diameter of 370mm which could not provide the full additional shear resistance required. Likewise, due to the presence of trees and the tight site boundary, soil nailing was also not adequate on its own.

The remedial measures were designed to minimize the risk of landslides progressing inland and to reduce the risk of associated damage to the new seawall. The failure modes addressed included shallow failures within the superficial deposits, identified translational failures and potential/conjectural deeper-seated failures.

The majority of identified failures occur on established limestone marker beds. Both dowel piles and soil nails act passively and will generate additional resistance to prevent failure should movement of the slope occur. Appropriate construction methods were utilised so as not to compromise any existing or proposed structures or drainage.

2 GEOLOGICAL SETTING

Due to its high scientific interest, the geology in the area of Lyme Regis is well established. The following strata are found in the area.

- Disturbed Lias / Active Slip Mass
- The Shales with Beef member in the lower part of the Charmouth Mudstone formation
- The Blue Lias formation

The Disturbed Lias has been subject to periglacial and/or landslide disturbance and extends from ground level to within 2m of the Table Ledge marker bed.

The Shales with Beef formation consists of thinly interbedded and organic rich mudstone with a few thin beds of limestone. In the area under consideration these marker beds, from higher to lower level, are:

- Table Ledge
- Fish Bed
- Grey Ledge (marks the top of the Blue Lias)

The Blue Lias formation comprises medium strong to very strong, thinly interbedded, grey to dark grey limestones, calcareous mudstones and siltstones with individual beds being up to 0.3m thick. No slope stability related failures have been recorded in the Blues Lias. This formation was, therefore, assumed to be stable.

3 FAILURE MECHANISM

The predominant failure mechanism at this area of Lyme Regis is compound translational failures with rotational movement in the area of the backscarp. Wholly circular failures can only occur as shallow slips which are not controlled by the presence of limestone bands. The translational movements are lithologically controlled by limestone beds that form identified marker horizons such as Table Ledge and Fish Bed.

The slope at the Cedar Cottage area of East Cliff (Figure 1), which will be the focus of this paper, has a maximum height of approximately 22m. The upper part of the slope has a gradient of about 10° and the lower slope down to the sea wall is slightly steeper. Local failure mechanisms consist of shallow translational slips directly above the Table Ledge marker horizon and shallow failures on the steeper lower coastal slope below the Table Ledge.

The presence of groundwater is of great importance to slope stability and the design of stabilizing measures as a consequence. Available groundwater monitoring data confirmed that the Table Ledge and Grey Ledge marker beds underdrain the formations above thus resulting in two perched groundwater surfaces.

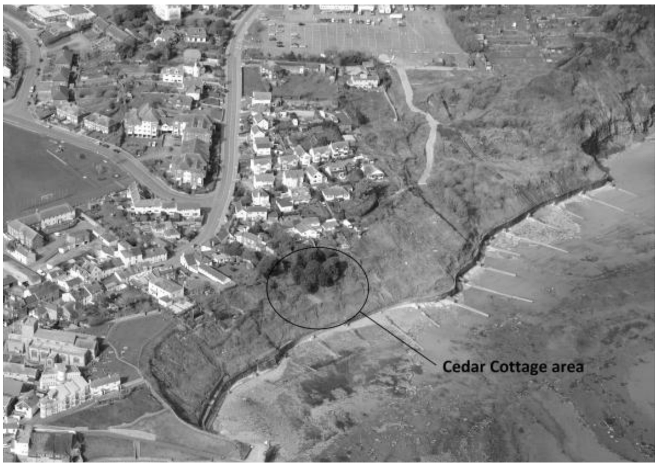


Figure 1. Cedar Cottage Slope Location

The geology in the area of concern is illustrated in Figure 2 along with the identified shear surface to be stabilised.

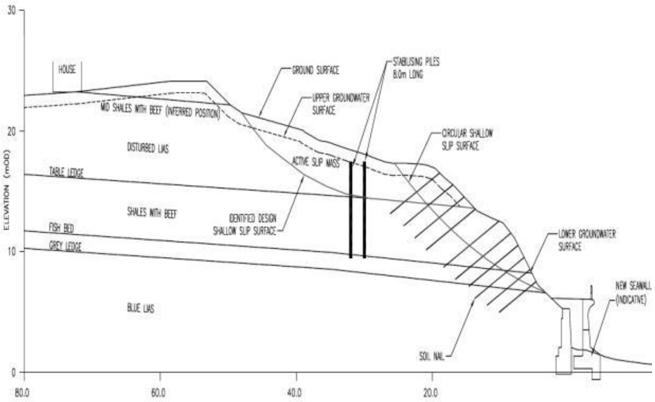


Figure 2. Geology, design groundwater conditions & stabilising measures.

4 DESIGN OF STABILISATION MEASURES

The following steps were followed for the design of the stabilisation measures.

- Setting up a ground model in the slope stability software Slope/W 2012 by GEO-SLOPE in order to determine the optimum soil nailing design.
- Establish the additional shear resistance to be provided by the dowel piles in order to achieve the target Factor of Safety.
- Determine the characteristics of the dowel piles using the method proposed by Viggiani (1981).

4.1 Geotechnical Design Parameters

Table 1 shows the characteristic material properties used in slope stability analysis.

4.2 Soil Nailing Design

The design of the soil nailing was undertaken in accordance with BS 8006-1:2011 while the design bond stresses for the grout-ground interface, presented in Table 2, were based on a series of sacrificial tests carried out in accordance with the requirements of BS 8006-1:2011 and BS EN 14490:2010.

Table 1. Geotechnical Design Parameters.

Formation	Bulk Unit Weight (kN/m^3)	Peak Parameters		Residual Parameters	
		φ' (°)	c' (kPa)	φ'_r (°)	c'_r (kPa)
Disturbed Lias / Active Slip Mass	19/18.8	20	0	11.5	0
Shales with Beef	19	25	5	11.5	0
Blue Lias	20	25	12.5	-	-

Table 2. Design Bond Stresses.

Formation	Characteristic Bond Stress (τ_k) (kPa)	Design Bond Stress (τ_d) (kPa)	Residual Parameters
		DA1C1	DA1C2
Disturbed Lias / Active Slip Mass	55	32	24
Shales with Beef	68	40	30
Blue Lias	100	59	44

A staggered soil nailing grid of 2:1 (h:v), as indicated in Figure 2, was utilised to stabilise the conjectured circular failures near the face of the slope. Owing to the greater than average horizontal soil nail spacing, the maximum forces arriving at the facing were determined to be in excess of 100kN. This required the design of a custom head plate and the specification of an appropriate facing mesh in order to achieve an adequate FoS against punching failure.

Slope stability calculations were undertaken with the use of Slope/W utilising the Morgenstern-Price method of analysis.

Due to previous movement and the effects of weathering, the presence of the limestone marker beds is not consistent close to the face of the slope thus introducing the risk of circular failures occurring. Soil nailing was utilised to improve the FoS of such failures.

The soil nailing was also designed to improve the stability of the identified shallow failure above Table Ledge. As previously mentioned, the soil nailing on its own was not able to provide the full resistance required to stabilise this slip.

The stability of deep conjectured failure surfaces was also investigated but the FoS were found to be satisfactory.

4.3 Stability Deficit Determination

For the shallow identified design failure surface above Table Ledge, the acting and resisting shear forces were extracted from Slope/W and the stability deficit was determined. The term "stability deficit" is used to indicate the additional shear resistance to be provided by the dowel piles at the slip surface in order to raise the FoS of the slope to the target values. The findings of the process described above are presented in Table 3.

Table 3. Stability Deficit.

Analysis	Depth of Groundwater (m bgl)	Acting Force (kN/m)	Resisting Force (kN/m)	Target FoS	Stability Deficit (kN/m)
ULS DA1C1	1.0	244.27	232.6	1.35	97
ULS DA1C2	1.0	262.59	177.03	1.00	86
SLS 1	0.0	192.83	175.75	1.10	36
SLS 2	1.0	191.66	240.02	1.30	9

4.4 Dowel Pile Design

The dowel piles were designed according to the requirements of BS EN 1997-1:2004 to enhance the stability of the identified shallow slip above Table Ledge. Poulos (1973, 1999), Viggiani (1981), Chmoulian (2004) and Carder (2005, 2009) were used in preparation of this design. Unlike continuous retaining structures, the dowel pile-soil system is reliant upon the ability of the soils to arch between adjacent piles so that the full disturbing force is transmitted to the piles.

The dowel piles were designed using the Viggiani (1981) method, which assumes two-layer cohesive soils with different properties above and below the slip surface. The soils can be assumed to be divided into an unstable upper mass and a stable lower mass, separated by an intermediate "drag zone", simplified as the slip surface. The manner ın which pile and soil interact determines the magnitude of the shear resistance that can be developed at the slip surface.

It is important to note that dowel piles are different from laterally loaded piles which are required to carry specific applied loads at specific FoS and are often designed using the methods of Broms (1964). Loads are not applied directly to dowel piles. Instead, shear forces and bending moments develop only in response to external displacements.

Dowel piles provide passive reinforcement to the slope. If no movement occurs between unstable and stable soil masses, the piles will not experience any lateral loading after installation.

The additional stabilising force is thus a strain-controlled problem and this has important implications for the design process and assumed mode of failure of the system.

Viggiani's method considers only the failure state without providing any indication of the development of shear force with ground movement. Undrained shear strength of the unstable and stable soil zones are assumed constant with depth.

Six possible failure modes are considered, three in which the pile remains rigid and three in which the pile itself yields to form a plastic hinge in the pile shaft above or below the slip surface, or both. The most critical failure mode depends upon the following:

- M_y - Yield moment of the pile
- c_1, c_2 - Undrained shear strength of the soil above and below the slip surface respectively
- L_1, L_2 - Length of the pile above and below the slip surface respectively
- k_1, k_2 - Bearing capacity factor of the soil above and below the slip surface respectively

The output from the Viggiani analysis consists of the ultimate shear force per metre run at the slip surface and the maximum bending moment per metre run in the pile above and below the slip surface.

Viggiani's equations relate strictly to the behavior of a single isolated pile. Extrapolating the results to a row of piles carries the assumption that the installed piles are wide enough apart that they do not interact in a manner that reduces the additional shear resistance that each pile is capable of providing.

Carder (2005) has indicated that a pile spacing of about 5 diameters is sufficient to minimise interaction between adjacent piles but has warned of differential movement between piles and ground at a spacing greater than 3 diameters. The ideal spacing should therefore be between 3 and 5 diameters, although this is likely to vary with the nature of the soils and the scale of the problem. At a spacing of less than 3 diameters, interaction between adjacent piles will be significant and the calculated resistance should be reduced accordingly.

Viggiani (1981) advised that the "most likely" values of the bearing capacity factors k_1 and k_2 for isolated piles were 4 and 8, respectively. However, these values should be reduced for a pile spacing of less than 3 diameters.

The method provides no information on the development of shear force with displacement. Poulos (1999) has indicated that movements as much as 0.6 times the pile diameter may be needed to develop the full ultimate resistance (T_u). However, 80% of this resistance may be developed at only 0.2 times pile diameter.

Where displacement is likely to lead to a decrease in the mobilised effective shear strength of the soils on the slip surface, a factor of at least 1.5 is normally applied to the ultimate shear resistance calculated using the Viggiani method. For this design, no reduction factor was applied as the soils in the failure zone are already presumed to be at their residual shear strength.

A c_1 of 60kPa and a c_2 of 100kPa were determined as the characteristic undrained shear strengths above and below the slip surface. Bearing capacity factors of $k_1 = 4$ for the unstable soil and $k_2 = 8$ for the stable soil were adopted for design. Finally, an L_1 value of 2.8m was used to take into account the fact that the top 600mm from the ground surface would have to be reinstated.

A 370mm diameter concrete pile, reinforced with a Circular Hollow Section with an external diameter of 219.1mm and a wall thickness of 12.5mm was selected for use in order for installation to be achievable with the use of lightweight piling plant.

The Viggiani analysis provided the length of pile below the slip surface (L_2) to mobilise the full capacity of the pile in terms of bending moment and the required pile spacing in order to achieve the target FoS. The results for all design cases are presented in Table 4.

Based on these results, a spacing of 1.5m was adopted. It was also decided that the piles would be installed in two rows, in a staggered pattern. The spacing of the two rows would be 2.0m and the spacing of the piles in each row would be 3.0m. The reason for this configuration was to avoid overstressing the ground where the 'cones' of soil resistance of the individual piles interacted while keeping the two rows close enough to act as a single row of piles.

Table 4. Summary of Results of Viggiani Analysis.

Analysis	L_2 (m)	Shear Resistance (kN/m)	Required Spacing (m)
ULS DA1C1	5.2	168.4	1.73
ULS DA1C2	5.2	130.5	1.53
SLS 1	5.2	168.4	4.63
SLS 2	5.2	168.4	18.43

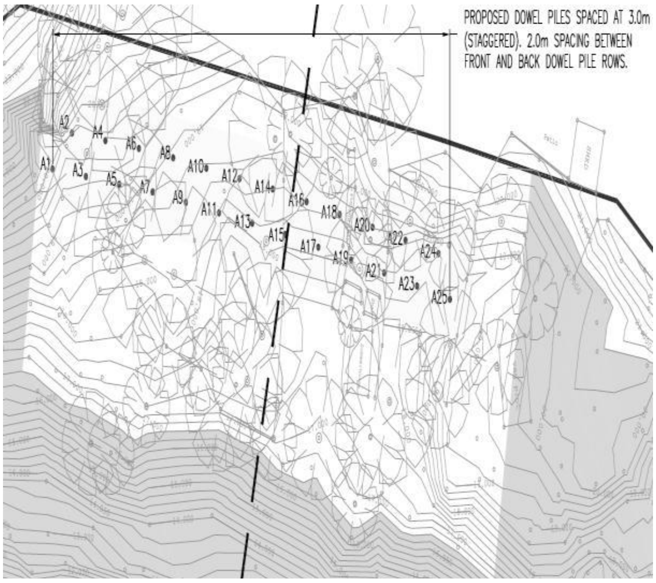


Figure 3. Plan View of the Stabilised Area.

4.5 Interaction of slope stabilisation measures

Although soil nails are a passive stabilisation measure, they require very little movement to mobilize their full resistance. In order for the combined stabilization measures to function as intended, it was necessary to provide a flexible soil nail facing system of suitable tensile strength which would be capable of deforming enough to allow the dowel piles to develop their full design resistance.

The method specified in BS 8006-2:2011 for the design of flexible facings was followed to determine the appropriate strength and stiffness characteristics required in order to avoid strain incompatibility derived complications. The use of Tecco G65/3 by Geobrugg or a product of equivalent properties was specified.

5 CONCLUSION

In many projects, the specific constraints often govern the option taken forward for detailed design and construction. In cases such as the one described in this paper, the designer may have to resort to "hybrid" solutions. Apart from the issues that must be dealt with in the design of the individual stabilization measures, the designer has to consider and accommodate strain compatibility problems where they occur.

ACKNOWLEDGEMENT

The author wishes to gratefully acknowledge the contributions of his colleagues at URS, Mr. I.F. Hodgson and Dr. S. Dyson. For their support and cooperation, the author would also like to thank Mr. N. Browning (West Dorset District Council), Mr. J. Cartwright (Balfour Beatty), Mr. C. Evans and Mr. G. Davis (CH2M HILL).The design was developed from a concept by High Point Rendel.

REFERENCES

Broms, B.B. 1964. Lateral Resistance of Piles in Cohesive Soils, *Journal of the Soil Mechanics and Foundations Division – Proceedings of the American Society of Civil Engineers* **90**, 27–62.

Carder, D.R. 2005. *TRL Report TRL632 – Design Guidance on the Use of a Row of Spaced Piles to Stabilise Clay Highway Slopes*, TRL, Wokingham.

Carder, D.R. 2009. *TRL Insight Report INS001 – Improving the Stability of Slopes Using a Spaced Pile Technique*, TRL, Wokingham.

Chmoulian, A.Y. 2004. Briefing: Analysis of piled stabilisation of landslides, *Geotechnical Engineering* **157**, 55–56.

Poulos, H.G. 1973. Analysis of Piles in Soils Undergoing Lateral Movement, *Journal of the Soil Mechanics and Foundations Division: Proceedings of the American Society of Civil Engineers* **99**, 391–406.

Viggiani, C. 1981. Ultimate lateral load on piles used to stabilize Landslides. *Proc., 10th. Int. Conf. Soil Mechanics and Foundation Engineering, Vol.* ***3***, 555–560. Balkema, Rotterdam, Netherlands.

Poulos, H.G. 1999. Design of Slope Stabilizing Piles, *Slope Stability Engineering – Volume 1*, A. A. Balkema, Rotterdam.

Design and Case Histories of Large Deep Excavations in Complex Urban Environment in Shanghai

W. D. Wang, Z. H. Xu, Q. Li

Abstract

With rapid infrastructure construction and urban redevelopment, there has been an increasing demand for utilization of underground spaces which give rise to a large number of excavation projects. In the past decade, a series of new trends have emerged on excavation engineering in Shanghai. As available ground resources in congested urban areas are scarce, excavations become much larger and deeper than before to maximize land use as much as possible. On the other hand, more and more excavations have to be carried out in close proximity to existing buildings, tunnels, utilities and other structures. Any severe damage to the nearby utilities probably lead to economic losses and complicated conflicts among owners, tenants, utility customers and the public. As a consequence, it is of great concern to not only ensure the safety of excavation itself but to mitigate adverse excavation-induced influences on adjacent environment. This paper presents recent developments in practical design and construction techniques of controlling excavation-induced deformations in Shanghai. Commonly used techniques including top-down construction method, ground improvement, zoned excavation method and underpinning technique are described and discussed, giving details of procedures involved and both advantages and drawbacks faced in each method. Relevant instrumented case histories executed by the authors' firm along with experiences on excavations in different types of urban environments are reported as well.

Introduction

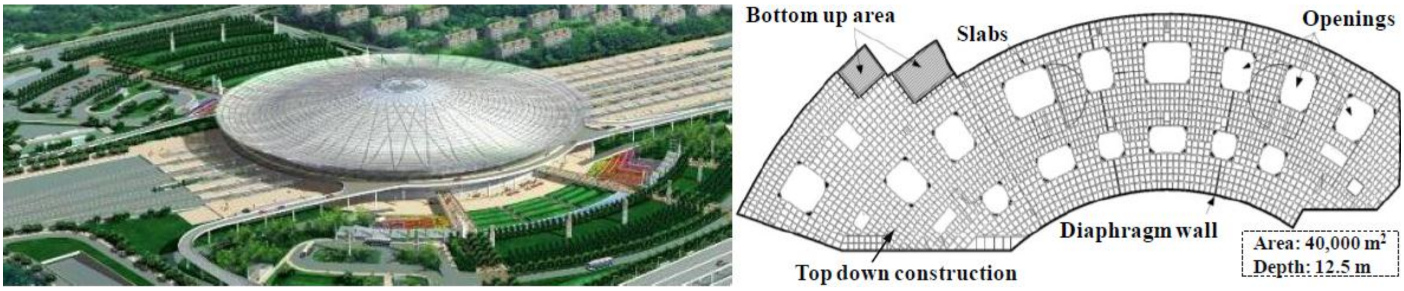
Shanghai is one of the important global financial centers having a population of more than 24 million as of 2014. In the past three decades, unprecedented economic development and urbanization lead to an increasing requirement of large underground spaces, which can serve as basements of high-rise buildings, metro tunnels and stations, underground power stations and infrastructures of various kinds. Whereas, ground resources readily available especially in urban areas are extremely scarce. Hence, property developers tend to specify deep basements to maximize land use. All the trends call for larger and deeper excavations than before. Nowadays, large scale deep excavations with an area of more than 100,000 m^2 are not rare. Figure 1(a) shows a typical large project of Shanghai Hongqiao international airport transport hub, which covers a footprint of 350,000 m^2. It is the biggest transport center in China, consisting of interchange stations for five different metro lines, two traffic squares, a high speed railway station, and a station for the Maglev train connecting Hongqiao and Pudong international airports (Wang et al., 2015). The excavation of the North Square of Shanghai South Railway Station as shown in Figure 1(b) reaches up to 40,000 m^2. For Shanghai International Financial Center in Figure 1(c), the area and the depth of the excavation are 42,000 m^2 and ranging from 26.6 m to 28.1 m, respectively. Both bottom up and top down construction methods have been used to construct the project.

Deep excavation has the potential to cause unfavourable effects on nearby ground as well as structures and facilities around it. With increasing number of excavations constructed in congested urban areas, it is necessary not only to ensure the safety of the excavation, but to minimize ground and wall displacements and hence to guarantee the serviceability of adjacent properties. Typical existing structures located in close proximity to an excavation involve but not limited to buildings founded on shallow and pile foundations, pipelines, metro tunnels and stations (see Figure 2), which are referred to as environment hereafter. Although design and construction of excavations are stringently regulated by national and local codes, unexpected damages to adjacent environment occur from time to time. It is always a challenge for geotechnical engineers to take appropriate measures to mitigate excavation-induced deformation so as to minimize its effect on nearby sensitive buildings and utilities, especially in soft clays. As a consequence, more issues have to be thoroughly considered throughout design and construction of excavations in complex urban environment.

In this paper, recent developments in practical design and construction techniques of controlling excavation-induced deformations in Shanghai are presented. Commonly used techniques including top-down construction method, ground improvement, zoned excavation method and underpinning are described and discussed, giving details of procedures involved and both advantages and drawbacks faced in each method. Relevant instrumented case histories along with experiences on excavations in different types of urban environment are reported as well.

Figure 1a. Typical deep and large excavation projects in Shanghai: Hongqiao International Airport Transportation Hub

Shanghai is located at the estuary of Yangtze River delta. During the late Tertiary and Quaternary periods (about three million years ago), the delta was subjected to alternating marine transgressions and regressions due to climate changes. The geology is composed of very thick (around 150-400 m) complex deposits consisting of thick clay layers sandwiched by sand layers (confining aquifers). The top 40-50 m soils are most frequently encountered in geotechnical engineering work. Gao et al. (1986) divided the uppermost 50 m soils in Shanghai into eight layers as described in Table 1. The top two layers are fill and yellowish silty clay. The second layer is over-consolidated and commonly referred to as stiff surface crust. Following are soft clay layers of thickness ranging from about 10 to 20 m. The soft clay has relatively higher natural water content, void ratio and compressibility but lower shear strength. Underneath the soft clay are layer ⑤-silty clay and layer ⑥-dark green stiff clay. Unlike the normally consolidated layer ⑤, layer ⑥ is over-consolidated and only has a thickness of about 3 m. Beneath the clay layers is a very fine to fine sand layer which is the first aquifer with a hydraulic head of about 3-8 m below ground surface.



(b)

(c)

Figure 1b,c. Typical deep and large excavation projects in Shanghai: (b) North Square of Shanghai South Railway Station and (c) Shanghai International Financial Center

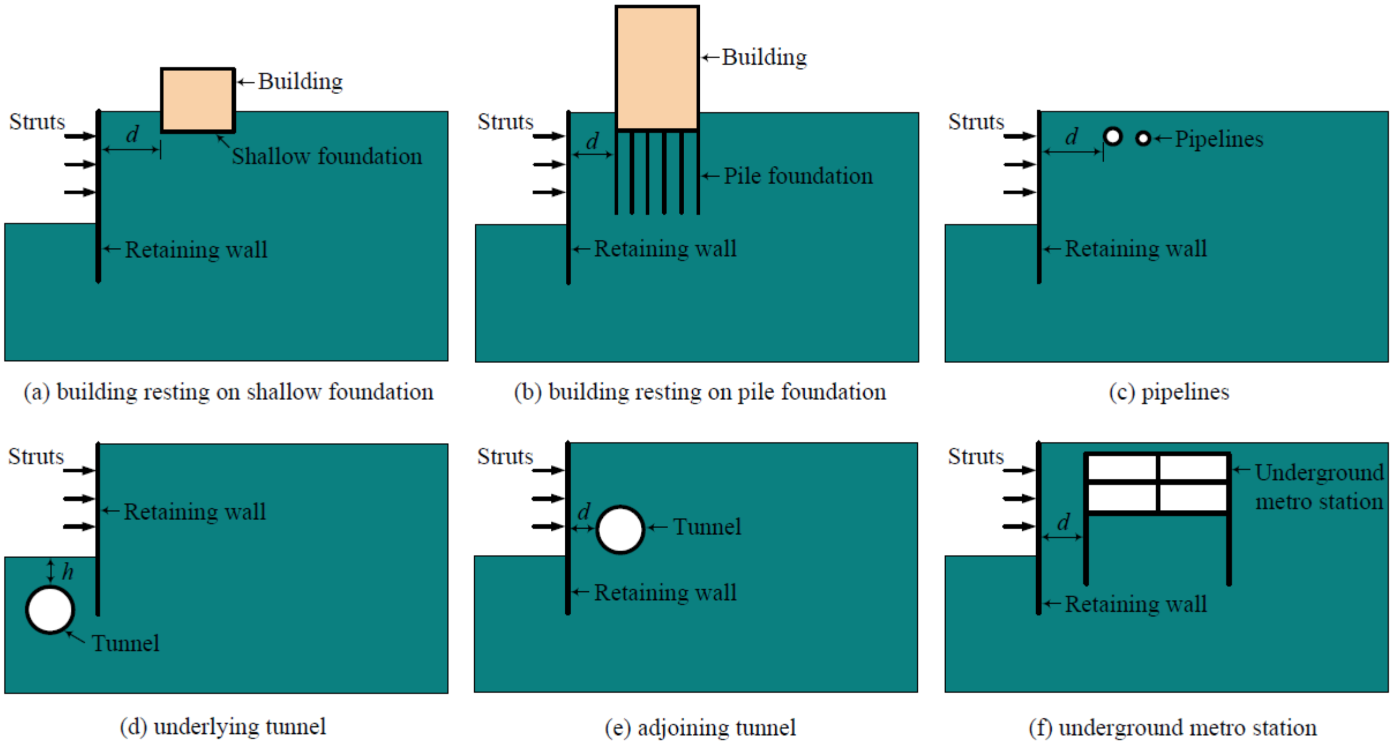


Figure 2. Structures located adjacent to excavations in urban areas

Table 1. Description of typical Shanghai soil strata (modified from Gao et al., 1986)

Sequence	Soil description	Thickness (m)	Geological origin	Notes
①	Fill	< 3	River estuary alluvial deposits	
②	Silty clay	2-3		Over-consolidated (Stiff surface crust)
③	Soft silty clay	5-10	Shallow sea deposits	Normally consolidated
④	Soft clay	3-10		
⑤	Silty clay	5-15	Littoral shallow sea marsh deposits; littoral-fluvial deposits	
⑥	Stiff clay	~ 3	Lacustrine deposits	Over-consolidated
⑦	Very fine to fine sand	5-15	Fluvial deposits	Aquifer I
⑧	Silty clay	20-30	Shallow sea deposits	

A typical soil profile and soil properties in Shanghai is shown in Figure 3. The unit weight (γ_t) of soils decreases from 19 kN/m^3 near the ground surface to 16.5 kN/m^3 at 10 m below ground in the soft/silty clay layer, and then increases to 19 kN/m^3 below 30 m. For the soft (silty) clay layers, the measured values of natural water content (w_n) are greater than the liquid limit of each soil, suggesting the soft and compressible nature of the soils. The undrained shear strength obtained from in-situ vane shear tests is less than 40 kPa. The variations in the measured void ratio (e_0) is consistent with the profiles of γ_t and w_n. The cone tip resistance *qt* increases gradually with depth in clay layers, whereas it increases suddenly to an average value of 10 MPa in the sand layer. The measured permeability of clay layers is of the order of 10-8 m/s, while the value for the fine sand (Aquifer I) can be as high as 10-5 m/s (Wang and Xu, 2012). The main ground water table is generally located at 0.5-1.0 m below the ground surface.

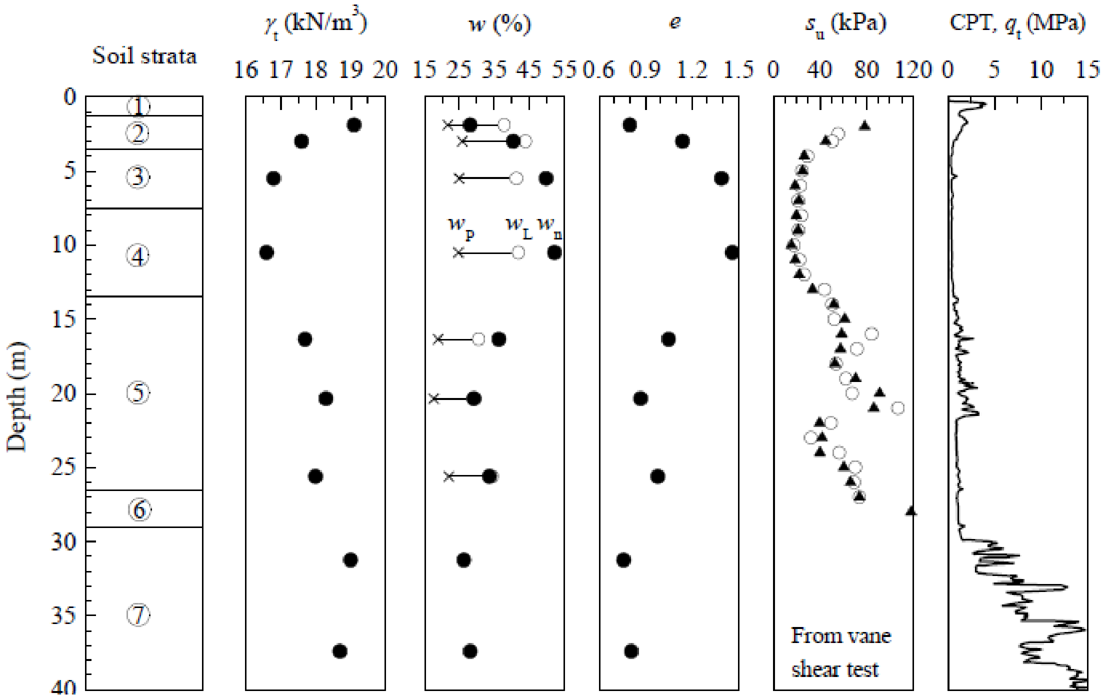


Figure 3. Typical soil profile and geotechnical parameters

Deformation Criteria

The design and construction of deep excavations in urban environment is often governed by the tolerance of adjacent environment to excavation-induced deformations. Precise prediction of the deformations due to a deep excavation using advanced numerical analysis is not simple because of the uncertainties in geological conditions, three-dimensional nature of the problem, incorporation of human factors and so on. Assessment on local reliable and well-documented case histories is an alternative approach to provide limiting deformation criteria against unacceptable damages and to give some guidelines for geotechnical engineers to make reasonable predictions.

In Shanghai, deep excavations can be categorized into three protection levels, depending on types of adjacent properties as well as the distance away from them (Table 2). For each level, the relationship between the maximum lateral wall displacements and excavation depth has been thoroughly investigated by using statistical methods on the basis of a large number of heavily instrumented case histories. The mean value of measured maximum lateral wall displacement is set to be the permissible wall displacement. The limit values of maximum wall displacement are found to be 0.18%*H*, 0.3%*H* and 0.7%*H* for Class I, II and III excavations, respectively. The maximum ground surface settlement are approximately 0.8 times the permissible maximum lateral wall displacement for all cases. According to practices in Shanghai, existing structures and properties have rarely been damaged as long as excavation-induced deformation are stringently controlled based on the criteria given in Table 3.

Table 2. Classification of excavations according to adjacent environment (SUCTC, 2010)

Neighboring conditions (type of structures and other properties adjacent to excavations)	Distance away from the excavation (*s*)	Protection level
Historic buildings, industrial plants with precise equipment and machinery, important buildings on shallow foundations or short pile foundations, metro tunnels, flood walls and other important infrastructures such as water, gas and sewer networks	$s \leq H$	I
	$H < s \leq 2H$	II
	$2H < s \leq 4H$	III
Normal buildings on shallow foundations or short pile foundations, infrastructures such as water, gas and sewer networks	$s \leq H$	II
	$H < s \leq 2H$	III

Note: *H* is excavation depth.

Table 3. Deformation criteria on excavations in Shanghai (SUCTC, 2010)

Protection level	Permissible maximum wall displacement	Permissible maximum ground settlement
I	0.18%*H*	0.14%*H*
II	0.3%*H*	0.25%*H*
III	0.7%*H*	0.55%*H*

Environmental Protection Techniques

It is well-acknowledged that removal of soil with the excavation process would inevitably lead to stress changes initiating noticeable ground deformations, the influence zone of which can extend to several times of the excavation depth behind the wall. As illustrated in Figure 4, protection of the nearby environment can be achieved by: (1) controlling deformations associated with excavations within desirable limits; (2) installing a barrier between the excavation and nearby structures to block the spread of induced deformations; (3) increasing the ability of affected structures to resist the deformations. Four commonly used protection measures including a top-down construction method, ground improvement, zoned excavation method and underpinning will be discussed, giving details of procedures involved and both advantages and drawbacks faced in each method.

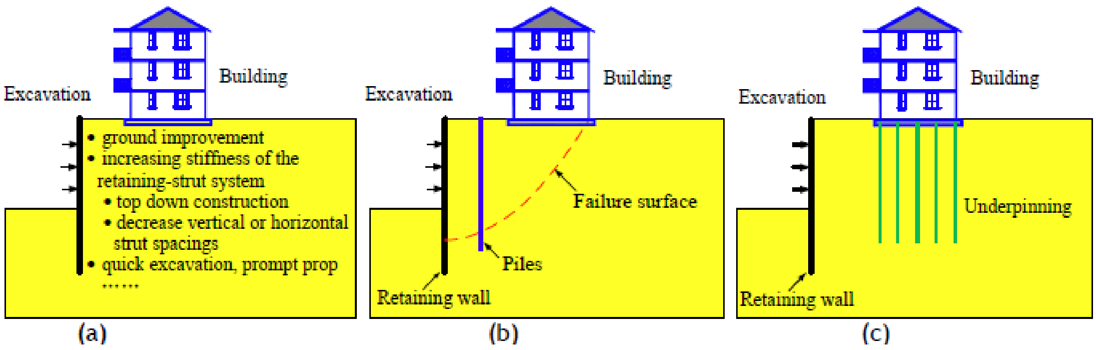


Figure 4. Mitigation of adverse influences on nearby environment by: (a) controlling excavation deformations; (b) installing a barrier to block spread of deformations; and (c) increasing structure's ability to resist excavation-induced deformations

Top down method

In contrast to the bottom-up method, in the top-down method, the ground floor slab is cast first and then excavation and construction of basement proceed downwards at the same time. It is effective to minimize lateral wall displacements, as retaining walls are restricted by floor slabs which are more stiffer than temporary reinforced concrete or steel struts. Wang et al. (2010) collected a total of 232 case histories of wall displacements for deep excavations in different types of neighbouring environment. Among these cases, 200 excavations were constructed by using the bottom up method while the other 32 excavations by the top down method. As demonstrated in Figure 5, the maximum average wall displacement δ_{hm} for the top down system is about 0.27%*H* (*H* is excavation depth), less than the value of 0.4%*H* for those using the bottom up method. The direct comparison suggests the top-down method is an option to minimize wall displacements and reduce adverse effects on adjacent properties in Shanghai soft clay.

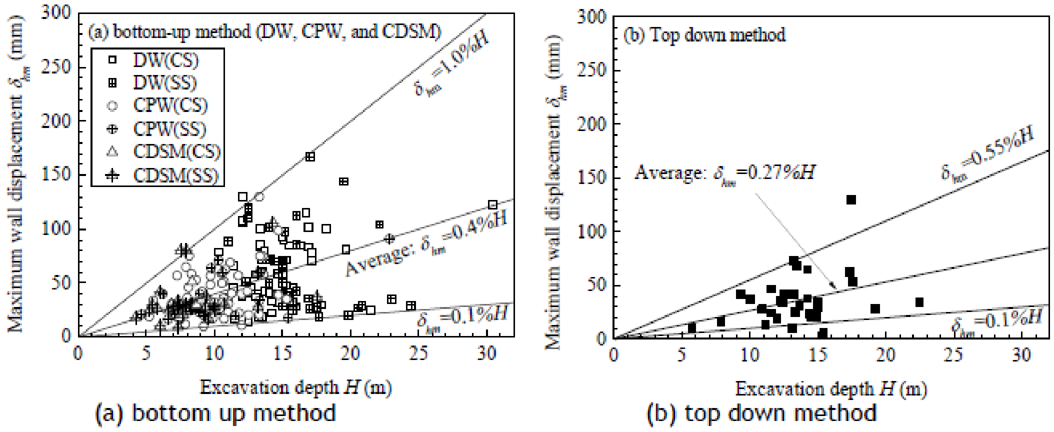


Figure 5. Comparison of maximum lateral wall displacements for excavations constructed using: (a) bottom up method; and (b) top down method (Wang et al., 2010)

Figure 6 shows the excavation of Shanghai 50 kV World Expo Underground Transmission and Substation, where only underground structures were continuously constructed together with downward excavation. Several openings were left in roof slabs allowing for transportation of spoil, materials and machinery as shown in the figure. An extension of the conventional top down method is concurrent upward and downward method, also called the up-down method, in which excavation and construction of superstructures are carried out simultaneously upon the completion of roof slabs. Figure 7 shows the excavation of Jing'an transportation hub, which was intended to alleviate the congested traffic problem in the densely populated area. The contractor expected the podiums to be open for use before all basements were completed. In this case, it was of advantages to use the concurrent upward and downward method to expedite the construction. In the end, not only the total construction program but also interests accrued on loan have been saved. The trend that more projects are constructed under fast-track schedule may also be an important driver to the growing popularity of the top-down construction method.

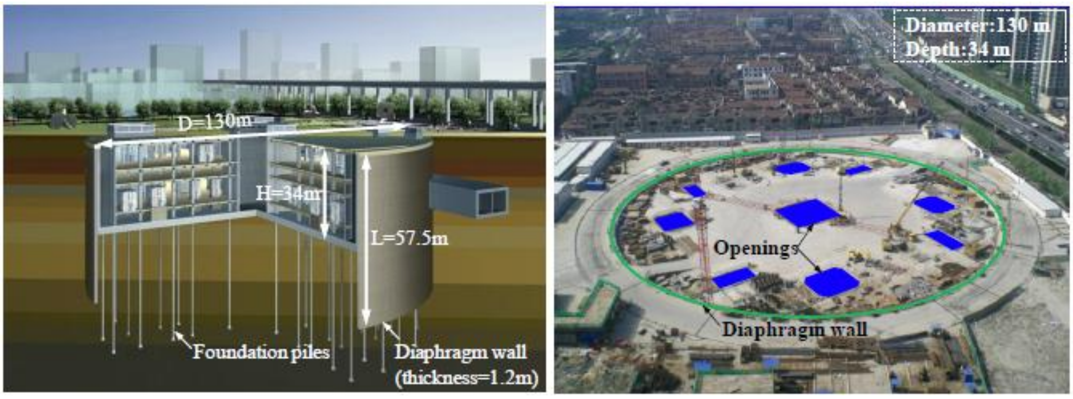


Figure 6. Excavation of Shanghai 50 kV World Expo Underground Transmission and Substation

Figure 7. Excavation of Jing'an transportation hub constructed using concurrent upward and downward method (excavation area=16000 m^2, excavation depth=17.2 m)

Ground improvement

The top 40 m soil deposits in Shanghai are relatively soft (refer to Table 1 and Figure 3). The deformations of retaining structures could not be fully controlled by only increasing wall stiffness when excavations are carried out in such soft ground. It is therefore necessary to increase ground stiffness and hence to restrain lateral wall deformations by improving soils inside excavation with cement slurry using either the deep-mixing method or the jet-grouting method. Two commonly used deep mixing methods are dual-auger method and triple-auger method. The principles of the two mixing system are identical, whereas the latter one can improve soil at greater depth. The deep mixing method utilizes mechanical augers, while the jet grouting utilizes pipes with high-pressure grouts. Typical design parameters of each method applied in Shanghai are summarized in Table 4, including water cement ratio, mass of cement slurry and 28-day unconfined compressive strength.

A number of variations in soil improvement arrangement are applied in practical excavation work, largely depending on geological conditions of the construction site and neighborhood environment conditions. The arrangements include block type, wall type, strip type and edge type. It is clear that block type and strip type are the most efficient in resisting lateral wall deformation because of the higher volume of treated soil, but on the other hand, they are much more expensive. Given such economic considerations, the wall type and edge type are more frequently used in practices in Shanghai.

Table 4. Design parameters of ground improvement techniques

Ground improvement techniques	Cement slurry (by mass)	Water cement (w/c) ratio	28-day unconfined compressive strength
Deep soil mixing (dual-auger)	13%	0.45-0.6	≥ 0.6 MPa
Deep soil mixing (triple-auger)	20%	1.5-2.0	≥ 0.8 MPa
Jet grouting	25%	0.8-1.5	≥ 1.0 MPa

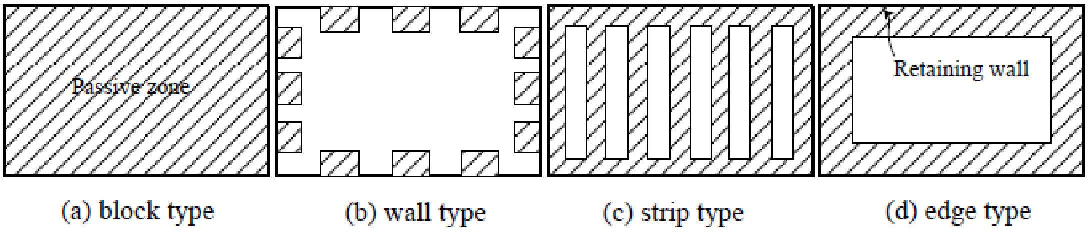


Figure 8. Arrangement of soil improvement inside excavations

Zoned excavation

Zoned excavation method is often applied in large-scale excavations where the construction site is separated into smaller zones and the excavation process is carried out zone-by-zone. Once the area is reduced, it can speed up the excavation process and construction of struts for each zone to form a complete retaining system early. This is important for the projects in soft clay where secondary compression may take a noticeable proportion of wall and ground deformations if the construction lasts for a long period. The excavation procedure in each zone is similar to conventional approaches.

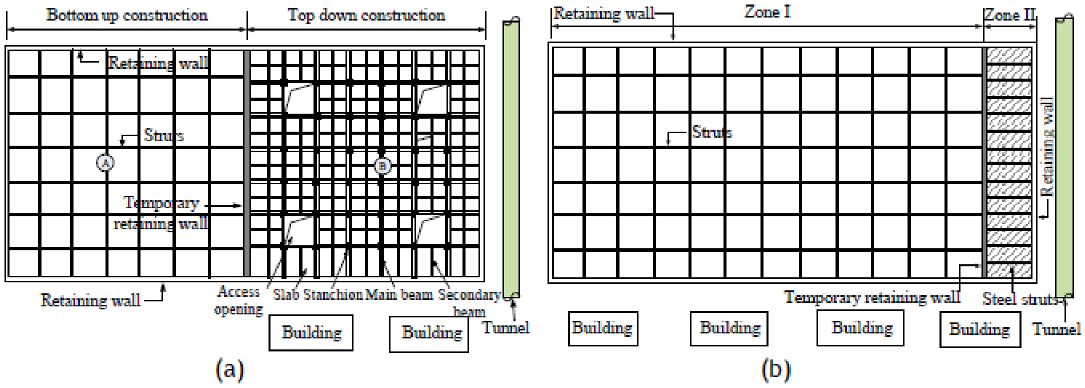


Figure 9. Schematic diagram showing zoned excavation: (a) combination of bottom up and top down construction; (b) zoned bottom up construction

As shown in Figure 9(a), a large-scale excavation is divided into two comparable zones, A and B. Each zone takes a different construction method according to the nearby environment conditions. Area A that is far away from existing buildings is constructed firstly using the bottom up method while keeping area B intact. Since the buildings are beyond the main influence zones of area A because of the existence of area B in between. The excavation-induced influences on the buildings are supposed to be limited during this stage. After completion of underground structures in area A, it proceeds to the construction of area B by using the top down method. As the result of large lateral stiffness the top-down method can provide, the effect of excavation on buildings tends to be less significant.

Figure 9(b) shows another common practice that splitting an excavation into a large area (Zone I) together with a narrow rectangular one (Zone II) in an attempt to ensure the safety of adjacent existing tunnels and metro stations. Based on practical experiences, the small rectangular area is generally set to be about 20 m wide. Prior to construction, the soil in the small area is improved by deep-mixing method in a block type. The rectangular area thus functions like a rigid wall that can reduce the magnitude of soil and tunnel movements towards the excavation. For some cases, the rectangular area would be further divided into a number of sections, each of which is about 50 m long.

The narrow excavation is generally supported by steel pipe struts of a diameter of 609 mm, which are mounted on steel wale beams or directly on diaphragm walls. In order to conform to the stringent regulation on tunnel movement of less than 20 mm, a novel load compensation servo system as shown in Figure 10 has been developed. The system is able to monitor the strut load constantly during the course of construction and to adjust the axial loading automatically once the observed value deviates largely from the permissible limit. The successful application of the strut system in a variety of projects has proved it to a reliable and efficient technique to reduce excavation-induced influences on nearby metro tunnels and stations.

Figure 10. (a) Load compensation servo for steel struts; (b) close-up of the connection between retaining wall and the servo

Underpinning

When a structure is located within the primary influence zones (Hsieh and Ou, 1998), excessive settlements and large angular distortions may generate, causing unintentional damages to the existing structure. This damage does not depend only on the induced ground deformations but also on the structural sensitivity of the affected building. Masonry load bearing walls or frames with masonry in-fill walls rested on shallow foundations are most vulnerable to differential settlement. Under certain circumstances, it is hence required to underpin a structure as a safeguard against possible settlements before the commencement of excavation. Underpinning is a broad term to describe the process of installing new supports under an existing foundation. There are a variety of underpinning methods and the selection of an appropriate underpinning technique is dependent on geotechnical conditions, access to foundations, type of existing building foundation, type of building structure, and magnitude of the building loads.

Shanghai city has many great historic buildings which were constructed in the late nineteenth or early twentieth century. Most of the buildings are typically composed of load bearing brick walls and columns supported on shallow foundations. These buildings are delicate and vulnerable to ground movements of small magnitude. Jack-down piling method has been used in Shanghai to reinforce fragile buildings in urban areas since it is almost silent and vibration-free. After the provision of a suitable reaction medium, e.g., existing or newly constructed reinforced concrete ground, segmental steel casings or precast concrete piles are jacked in sections to a designed depth, as we can see from Figure 11. The piles are concreted and bonded to existing columns. Because of the unique size and adaptability of jack rigs, the jack-down piling method can be used in the most difficult areas with small operating clearance.

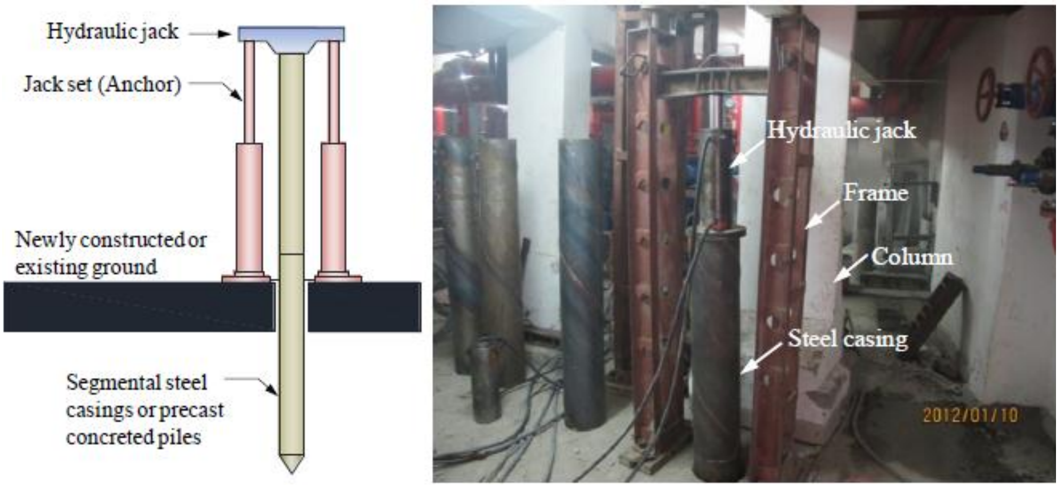


Figure 11. Underpinning column foundation with jack-down piles

To protect brick walls of the delicate buildings, a pair of piles are installed on either side of the affected wall. A pocket of brickwork is then removed and a steel cage is installed to span over the two piles at intervals. To improve the integrity of the new foundation, the needle beams are often connected by a reinforced concrete beam as shown in Figure 12. Compared with traditional underpinning methods which entail a large amount of excavations and labor work, the aforementioned underpinning techniques are quicker and result in less disturbance to these buildings.

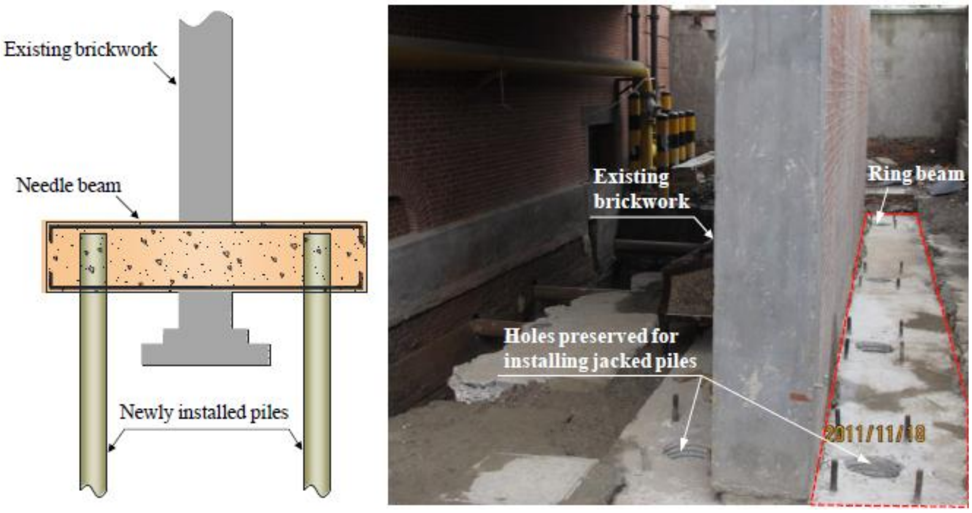


Figure 12. Underpinning brick wall foundation with pile and beam

Case Histories

Xingye Building

Figure 13 shows the plan view of excavation for Xingye Building which is located in the old downtown of Shanghai. The building has 19 floors above the ground and a three-level basement. The excavation depth of the west side and east side of the basement was 14.4 m and 12.4 m, respectively. The construction site, covering a footprint of 7,800 m^2, was adjacent to 15 existing buildings, among which Building A ~ Building H were historic buildings. Building A is a reinforced concrete frame structure constructed in 1949. It is rested on a piled box foundation, which utilizes wooded piles driven into a stiff clay layer. The distance from periphery of the excavation to the historic building was about 8.0 m. Besides, a large number of old pipelines were embedded underneath Hankou Road and Sichuan Road. Anxiety on safety may arise if excavation activities lead to cosmetic or further structural damages to these old buildings. The excavation is hence classified as Class I with respect to the protection level as indicated in Table 2. Top-down construction method was adopted in an attempt to protect the old buildings and pipelines. A 1 m-thick diaphragm wall was installed to a depth of 31.2 m at the west and south sides that were close to the existing historic buildings, while a 0.8 m thick diaphragm wall was used for the north and east sides. To reduce the effects of wall installation on the delicate buildings, each wall panel was 4.2 m long rather than the common practice of 6 m in Shanghai. Concrete-filled steel tubes of a diameter of 609 mm were taken to support the vertical loading of underground structures during the course of excavation, and the steel tubes were finally encased with concrete to form the permanent columns. In addition to adopting a top-down method, peripheral 6 m-wide soil inside the excavation was improved from the ground surface to 5 m below the formation level to enhance the resistance to lateral ground and wall deformations.

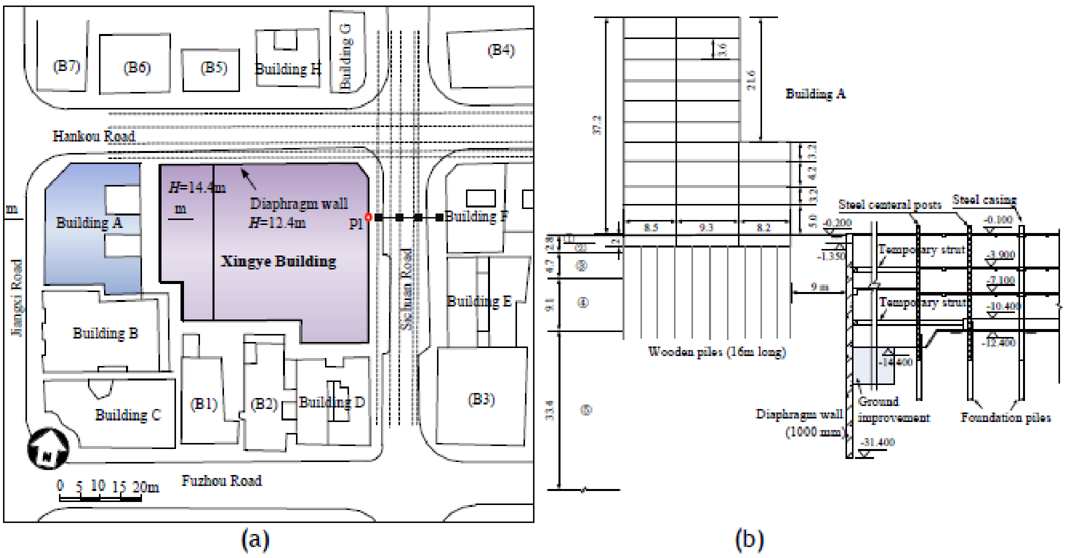


Figure 13. Excavation of Xingye building: (a) plan view; (b) cross section *m-m*

Figure 14 shows the development of lateral wall displacements at P1 as well as corresponding ground surface settlements behind the wall. Prior to the construction of roof slabs, cantilever-type wall displacement was observed when soil was removed. Afterwards, since the top of the wall was resisted by the roof slab, a deep-seated profile developed as the excavation proceeded downwards. Upon completion of bottom slabs, the measured maximum lateral wall movement was 37.9 mm, which is equal to about 0.3% of the excavation depth (*H*). As expected, the ground surface settlement δ_v decreased with an increase in the distance from the diaphragm wall. The δ_v reached to its maximum value of 22.4 mm at about 10 m behind the wall and then decreased gradually. The ground surface settlement profile turns to be a concave type (Ou, 2006), and the influence zone extends to at least 2*H* behind the wall. The ratios of $\delta_{v\text{-max}}$ to $\delta_{h\text{-max}}$ ranges from 0.6 to 0.7, slightly less than the results measured by Ng et al. (2012) in a narrow rectangular excavation.

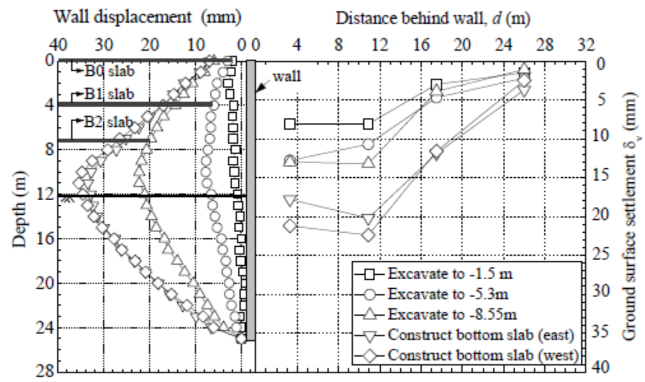


Figure 14. Measured lateral wall displacements and ground settlements at P1

According to the evaluation report of Building A, some cracks already existed in the in-filled brick walls prior to excavation. Figure 15 shows the settlement profile of Building A at the final excavation stage. Although the maximum settlement of the building was up to 27.2 mm, the measured maximum angular distortion was about 1/780, which was less than the empirical limit value of angular distortion of 1/500 for a reinforced frame structure proposed by Polshin and Tokar (1957). As a result, the structures of the building were not subject to further damages during the course of the excavation.

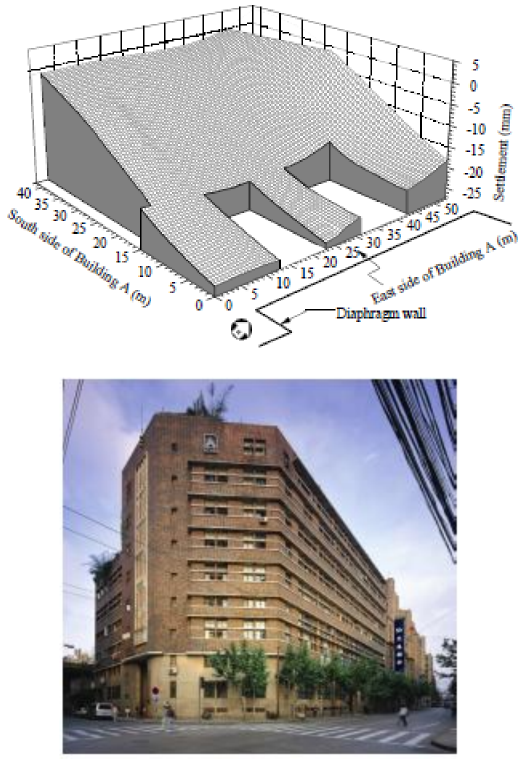


Figure 15. Settlement profile of Building A at the final excavation stage

Jing'an Transportation Hub

The Jing'an Transportation Hub is located in the downtown area of Jing'an district. The project comprised a 20-story tower and 8-story podiums equipped with a three-level basement (refer to Figure 16 for the architectural drawings). The construction site occupied an area of about 15,916 m2. As shown in Figure 16, there existed roads, metro tunnels, buildings as well as various types of pipelines around the site. The shield tunnels of Metro Line 7 (in service) run parallel to the east side of the excavation and were embedded about 10 m underneath the Changde Road.

The minimum distance between the tunnels and the excavation was only about 8.6 m. On the south side stood an old Building B, which was about 12 m away from the excavation. The building had 8 stories and was rested on piled raft foundations with a pile length of 18 m. The buildings on the east side were also close to the site. The excavation depth at the tower area was 15.0 m and ranged from 14.5 m to 15.2 m for the podium area.

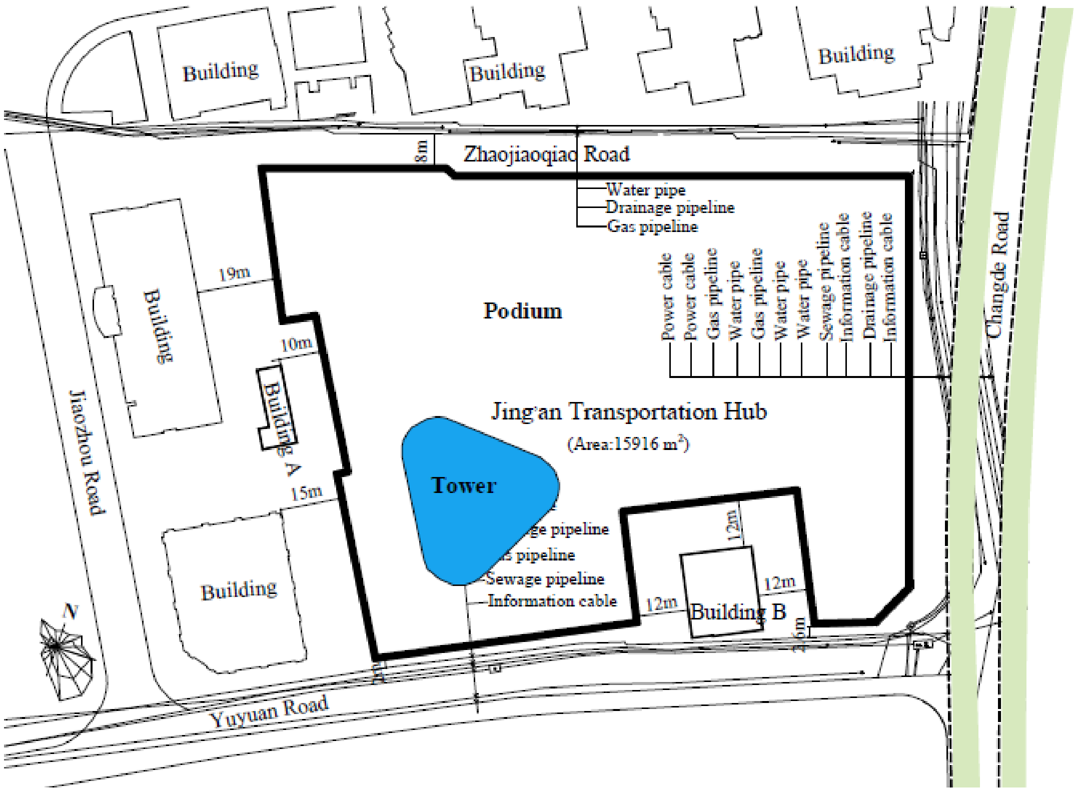


Figure 16. Plane view of the construction site and adjacent environment

Considering the excavation area, the excavation depth, and the protection requirements of the adjacent facilities, zoned excavation technique was adopted in this project. The excavation was divided into a relatively large pit (Zone II) and a small one (Zone I), as shown in Figure 17. Zone I was 16.3 m wide and adjacent to the metro tunnels. The two excavations were separated by a temporary diaphragm wall in between. Zone I was constructed first by bottom-up method. Upon the completion of underground structures in the small area, Zone II was constructed by using the top-down method.

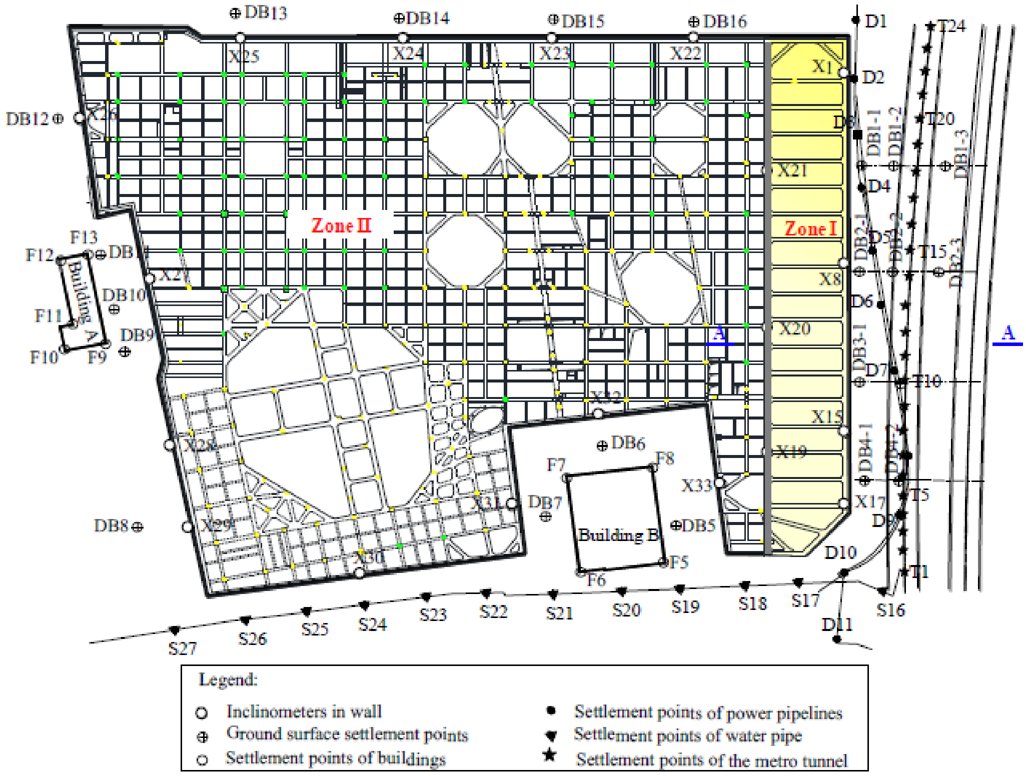


Figure 17. Zoned excavation plan and layout of instrumentation

The small narrow excavation (Zone I) was retained by a 1000 mm thick diaphragm wall along the side adjacent to tunnels. The embedded length, i.e., the wall length below the final formation level was 22.9 m. While a 800-mm thick diaphragm wall was installed to be the temporary retaining wall between the two zones. The excavation was supported by four levels of struts. The first level prop used 800 mm × 800 mm reinforced concrete struts while the other three utilized steel tube struts with a diameter of 609 mm and a thickness of 16 mm. All the struts were installed at a 6 m spacing in plan. Instead of using reinforced concrete or steel struts, structural slabs were used to resist lateral wall displacements in Zone II. The roof slab (B0) was designed as a platform for soil excavators, trucks and other construction machines to walk on. Big access openings (see Figure 17) were left in the roof slabs to facilitate the transportation of soil spoil and delivery of building materi-als. A big opening was also left at the tower area. The exca-vation at this part was temporarily supported by reinforced concrete struts. Upon completion of bottom slabs, the tower building was constructed upwards. Details of retaining structures can be referred to Figure 18.

The excavation was heavily instrumented (refer to Figure 17) and the responses of retaining structures together with nearby tunnels, buildings and pipelines were continuously monitored throughout construction. Figure 19 compares lateral displacement profiles of diaphragm walls in Zone I and Zone II. It can be seen that the lateral displacement of wall gradually developed into a deep-seated profile as the excavation proceeded downwards. From the second level of strut (-6.1m) to the formation level, all excavation activities were carried out in soft (silty) clay layers. As expected, lateral wall displacement increase significantly accordingly. The maximum lateral wall deflection δ_m of X1 and X8 were 16.7 mm and 20 mm, being equal to 0.11%*H* and 0.13%*H*, respectively. It took about 10 days to cast bottom slabs. During this period, noticeable lateral displacement increment was observed. It can also be found that the maximum lateral displacement generally occurred underneath the formation level in the bottom up constructed area.

Figure 19b shows typical lateral wall displacement at X30 and X33 in Zone II. The wall displacement profile agreed broadly with those in Zone I, but the magnitude was much larger. The maximum wall deflection δ_m of X30 and X33 were 70.2 mm and 60.5 mm, being equal to 0.46%H and 0.40%H, respectively. The larger wall displacements may be attributed to the following reasons: (1) the area of Zone I was much smaller than that of Zone II so that excavation of Zone I was much faster; (2) average vertical strut spacing in Zone I was smaller than that in Zone II; (3) a thicker diaphragm wall was used for the retaining structures adjacent to the tunnels; (4) the entire area of Zone I was fully improved while in Zone II only the peripheral passive zones were improved. The maximum lateral displacement occurred above the formation level, being similar to the wall responses observed in Xingye Building which used top down method as well (see Figure 14).

Figure 19b shows typical lateral wall displacement at X30 and X33 in Zone II. The wall displacement profile agreed broadly with those in Zone I, but the magnitude was much larger. The maximum wall deflection δm of X30 and X33 were 70.2 mm and 60.5 mm, being equal to 0.46%H and 0.40%H, respectively. The larger wall displacements may be attributed to the following reasons: (1) the area of Zone I was much smaller than that of Zone II so that excavation of Zone I was much faster; (2) average vertical strut spacing in Zone I was smaller than that in Zone II; (3) a thicker diaphragm wall was used for the retaining structures adjacent to the tunnels; (4) the entire area of Zone I was fully

improved while in Zone II only the peripheral passive zones were improved. The maximum lateral displacement occurred above the formation level, being similar to the wall responses observed in Xingye Building which used top down method as well (see Figure 14).

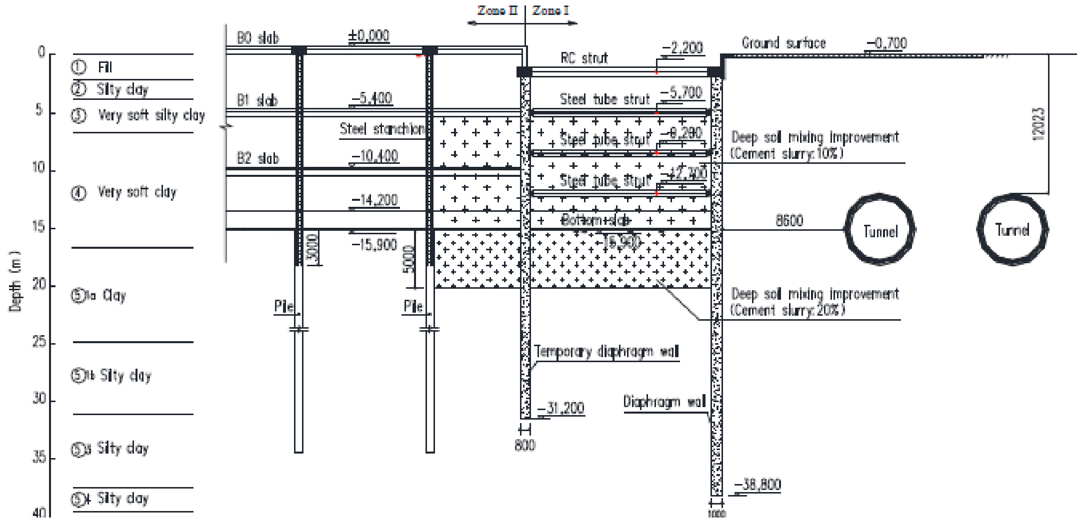


Figure 18. Cross section and geometry of excavation along A-A

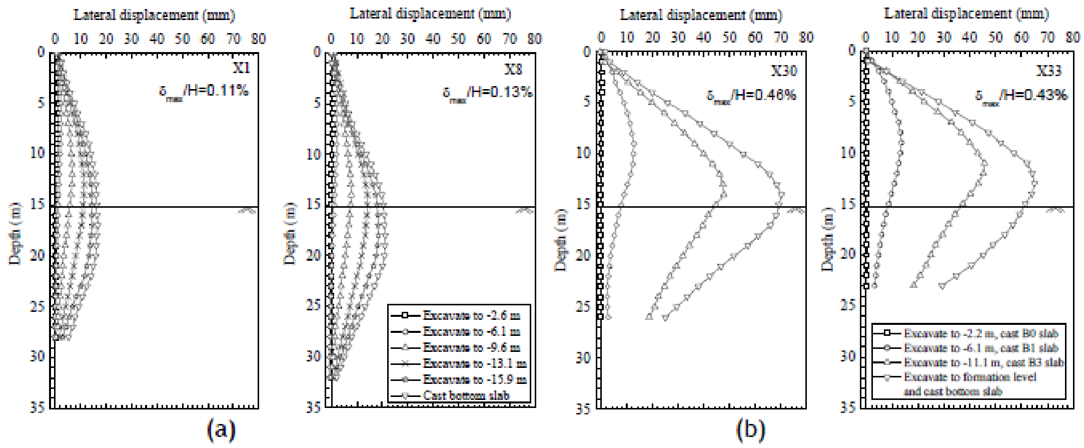


Figure 19. Comparison of lateral wall displacements at: (a) Zone I; (b) Zone II

Figure 20 shows the vertical tunnel movements along the longitudinal tunnel axis. When Zone I was excavated to the formation level, most of tunnel linings moved downward except for locations from T17 to T21. The maximum tunnel settlement and heave were 8.5 mm and 2.8 mm, respectively. During the subsequent excavation of Zone II, tunnel linings moved downward almost uniformly. Another 4.5 m settlement was recorded during the period. When excavation in Zone II was finished, the maximum settlement of the tunnel was found to be 13.1 mm, which was within the acceptable limit of 20 mm (Hu et al., 2003). The maximum angular distortion was 0.059%, occurring near T10. No obvious structural damage was observed to tunnel linings and the normal service of the metro line was rarely affected by construction activities of the excavation.

DingDing Bund Building

A four-story basement for the DingDing Bund building was constructed in the bund area in downtown Shanghai. Figure 21 shows the plan view of the site. The construction of the basement involved an excavation of 20,000 m2 in area and 19.8 m in depth supported by diaphragm walls. As the site is located in downtown area, the environment in the proximity of the excavation is very complex. There were three buildings, i.e., main building, south building and north building, which were built in 1906 and have been preserved as historical buildings on the northeast of the excavation. All the three buildings were reinforced masonry buildings, which used brickwork as load bearing walls and steel pipes or reinforced concrete to construct structural columns. Most of the loading bearing walls and interior columns were rested on stepped spreading footings made of brick. The closest distance from the excavation to the buildings was only about 3.0 m.

On the south of the excavation lied Renmin Road tunnels which run across Huangpu River connecting Pudong and Puxi areas. The two tunnels were 6.7 m apart and embedded about 14 m to 22 m below the ground surface. The tunnel diameter was 11.36 m. As shown in the figure, the minimum distance between the excavation and the tunnels was 9 m. Moreover, there were bund tunnels and a lot of pipelines around the excavation. The details of the bund tunnels and pipelines are not presented in this paper.

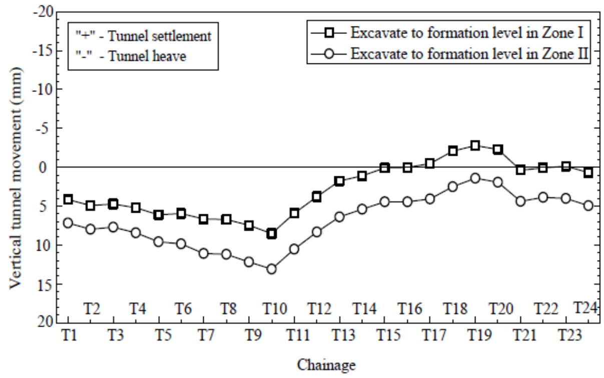


Figure 20. Measured longitudinal vertical tunnel movements

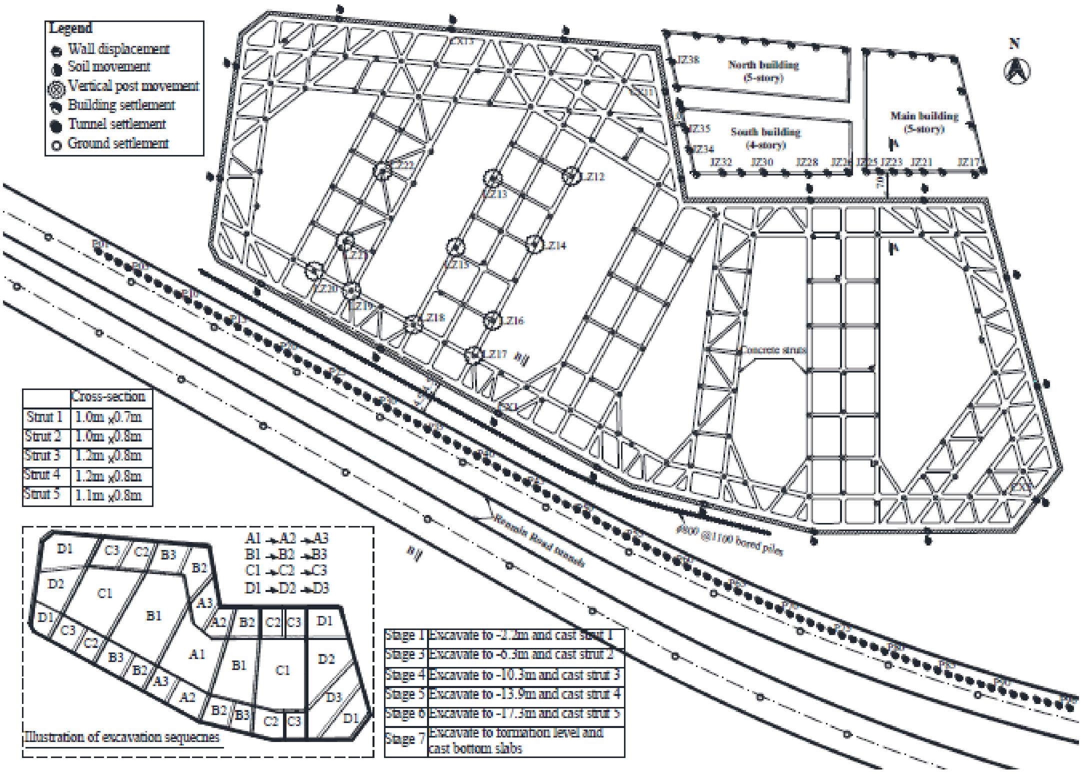


Figure 21. Plan view of construction site and monitoring layout

As the environments around the excavation were complicated, 1000 mm-thick diaphragm walls which were supported by five levels of concrete struts were adopted for most areas. The dimensions of each level of struts are given in Figure 22. The first level of struts used C30 concrete whose 28-day compressive strength was 14.3 MPa. For the rest of struts, C40 concrete of compressive strength of 19.1 MPa was adopted. The embedded depth of the diaphragm wall varied from 18.0 m to 34.0 m along the perimeter of the excavation depending on both geological conditions and adjacent environments to be protected. Two rows of mixed-in-place piles were constructed along either side of the diaphragm wall to reduce the influence of wall installation on adjacent environments. Besides, soil at the excavated side from underneath the second level strut to six meter below formation level (shadow area as shown in Figure 22) was improved by triple-auger deep mixing method.

In order to protect the historical buildings, diaphragm walls near the buildings were increased to be 1200 mm thick. During the design stage, we proposed that the contractor should underpin the three historic buildings before the main excavation commenced. However, due to some unknown reasons, this work did not commence until the completion of diaphragm wall installation. The procedures of underpinning outside brick walls are illustrated in Figure 23. The ground was first excavated to a certain depth to expose spread footings, where a pocket of brick was removed at intervals. Segmental steel pipes were then jacked down to a depth of 30 m on either side of the wall. Steel cages were installed to span over the brick foundation to form a needle beam. Finally, concrete was poured to allow for a connection of jack-down piles, needle beams and the ring beam. The interior columns were also underpinned by jack-down piles which were connected by a newly constructed reinforced concrete slab.

To reduce the influence of excavation-induced soil movement on Renmin Road tunnels, a contiguous pile wall comprising of 800 mm diameter bored piles at 1100 mm centers was constructed in the middle of the excavation and the tunnel. The excavation was carried out by using the bottom-up method. The soil in middle of the excavation, i.e., Zone A, was first removed followed by Zones B to D in sequence. For each zone, soil was excavated in numerical order (see the inset of Figure 21).

Figure 24 shows the lateral wall displacements behind the wall at each stage. The measured data at Stage 9 when the second level underground floor slab was constructed is also included for comparison. Before the bottom slab being cast, the lateral wall displacements increased significantly as the excavation proceeded. The wall deformed in a deep-seated profile and the maximum wall displacement occurred near the formation level. Once the bottom slab was completed, additional lateral wall displacements were negligible or even reduced. As shown in this figure, the maximum wall displacements δ_{max} fall in the range of 0.24%*H*~0.58%*H* (*H* is excavation depth). The lateral wall displacement at CX5 is smallest due to corner effects. Since diaphragm walls at CX11 are 1200 mm thick and offered relatively stiffer supports, the measured wall displacements are smaller than those at point CX1 where 1000 mm-thick walls were used.

It should be noted that the historical buildings were not underpinned until diaphragm walls and foundation piles had been constructed. As illustrated in Figure 25, the delicate unreinforced buildings settled more than 25 mm just during the course of wall installation, contributing to about 50% of the final building settlement. After completion of underpinning work, the influence of excavation on the buildings were limited until it was excavated to the fifth level of strut. Building settlements increased significantly when the final 3 m thick soil was removed. Considering the short distance between underpinning piles and the excavation, the excavation-induced deformation may change stresses behind the wall and alter the shaft resistance along the piles. Both the total and differential settlements need to be analyzed to evaluate the building response. The maximum differential settlement was found to be 1/1800, and no obvious structural damages were observed.

Figure 26 shows the development of tunnel movements with time. Since P05 was beyond the excavation while P90 was 42 m away from the excavation, the vertical tunnel movements due to excavation were less than 3 mm at the two locations. For other locations, tunnel linings continued to heave during the principal excavation period, from Stage 2 to Stage 6. It is postulated that the ground heave due to stress relief was dominant in the period and the soil behind the wall heaved, causing the tunnel to move upward together. The maximum tunnel heave was 15.5 mm. The structural integrity of the tunnels was protected well and it operated smoothly throughout the excavation process.

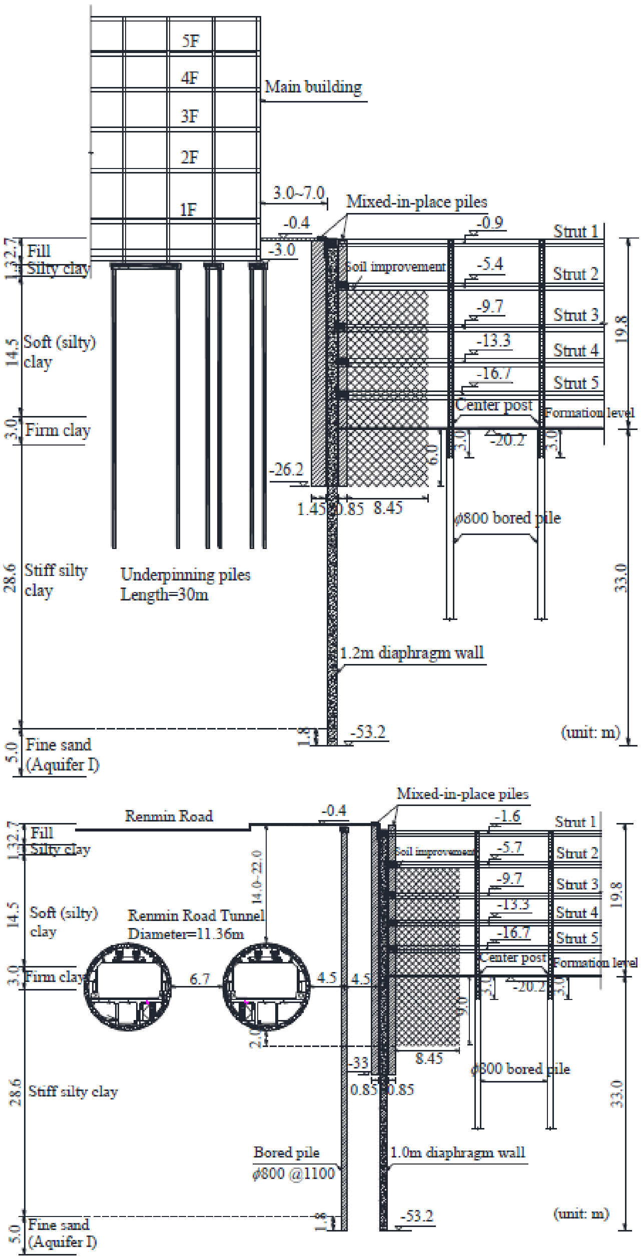
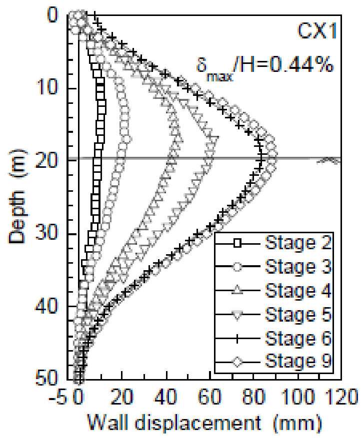


Figure 22. Relationship between excavation and adjacent: (a) historical buildings; (b) tunnels

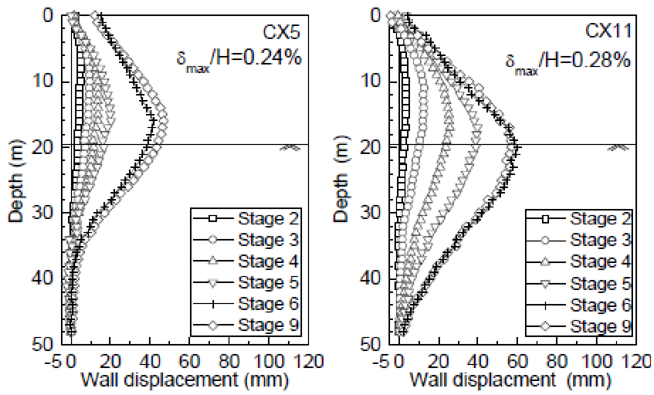
(a)

(b) (c)

Figure 23. Photos showing the sequence of underpinning work: (a) excavation; (b) installation of jack-down piles; (c) installation of steel cages



(a)



(b) (c)

Figure 24. Measured lateral wall displacements at: (a) CX1; (b) CX5; (c) CX11

Conclusions

Ground deformations due to excavation, and their effects on the adjacent environment, are increasingly important as more underground construction is undertaken in urban areas, but their influences on nearby existing buildings, tunnels, utilities and other structures are too often neglected. In Shanghai, excavations are categorized into three protection levels for engineering purposes, depending on types of adjacent environment as well as the distance away from it. Deformation criteria associated with lateral wall displacements and ground surface settlements vary with protection levels.

Ground deformation control and protection of adjacent properties remain challenging for deep excavations in soft clays. Various types of protective measures have been commonly applied to control ground movements or increase the ability of adjacent structures to tolerate those movements in Shanghai. Those measures include, but not limited to, ground improvement technique, top down method, zoned excavation technique and underpinning. Four relevant case histories in different urban settings have been successfully constructed, proving the aforementioned techniques to be effective in mitigating excavation-induced influences on nearby environment in Shanghai soft clays. The selection of the mitigating measures must be made with comprehensive considerations of geological conditions of the construction site, types of structures to be protected, adjacent environment conditions, and so on. As the theory and practice of excavation develop, more innovative design and construction techniques are expected in the future.

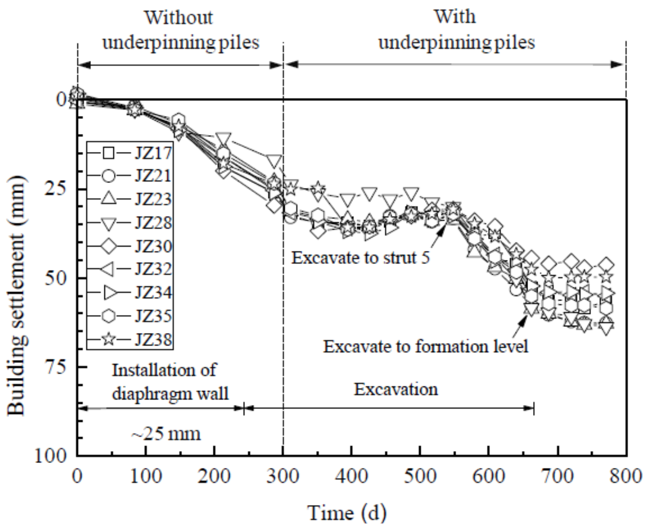


Figure 25. Measured building settlements

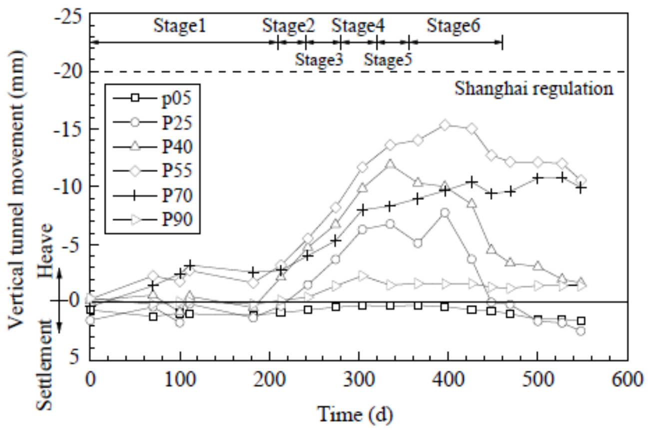


Figure 26. Development of tunnel movements with time

References

Gao, D. Z., Wei, D. D. and Hu, Z, X. (1986). Geotechnical properties of Shanghai soils and engineering applications. *ASTM Special Technical Publication,* 161-177.

Hsieh, P. G. and Ou, C. Y. (1998). Shape of ground surface settlement profiles caused by excavation. *Canadian Geotechnical Journal,* 35(6)*,* 1004-1017.

Hu, Z. F., Yue, Z. Q., Zhou, J. and Tham, L. G. (2003). Design and construction of a deep excavation in soft soils adjacent to the Shanghai Metro tunnels. *Canadian Geotechnical Journal,* 40(5)*,* 933-948.

Ng, C. W. W., Hong, Y., Liu, G. B. and Liu, T. (2012). Ground deformations and soil-structure interaction of a multi-propped excavation in Shanghai soft clays. *Géotechnique,* 62(10)*,* 907-921.

Ou, C. Y. (2006). Deep excavation - theory and practice, Taylor and Francis Group.

Polshin, D. E. and Tokar, R. A. (1957). Maximum allowable non-uniform settlement of structures. In Proceedings of the 4th International Confefence on Soil Mechanics and Foundation Engineering, 1(1), 402-405.

Shanghai Urban-rural Construction and Transportation Commission (SUCTC). (2010). Technical code for excavation engineering (DG/TJ08-61-2010). (in Chinese)

Wang, J. H., Wang, W. D., Li, Q. and Xu, Z. H. (2015). Design and performance of large excavations for Shanghai Hongqiao International Airport Transport Hub using combined retaining structures. Journal of Aerospace Engineering-ASCE, 28(6).

Wang, J. H., Xu, Z. H. and Wang, W. D. (2010). Wall and ground movements due to deep excavations in Shanghai soft soils. Journal of Geotechnical and Geoenvironmental Engineering, 136(7), 985-994.

Wang, W. D. and Xu, Z. H. (2012). Design and construction of deep excavations in Shanghai. In proceedings of the 7th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, Roma, Italy. Viggiani (ed.), Taylor & Francis Group, 667-683.

(ISSMGE Bulletin: Volume 9, Issue 6, Major Project, pp. 18-39)

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΜΗΧΑΝΙΚΩΝ

Γιώργος Γκαζέτας

Βραβείο Εξαίρετης Πανεπιστημιακής Διδασκαλίας «Βασίλη Ξανθόπουλου - Στέφανου Πνευματικού»

Το Ίδρυμα Τεχνολογίας και Έρευνας (ΙΤΕ) απένειμε στον Καθηγητή Εδαφομηχανικής και Εδαφοδυναμικής του Εθνικού Μετσόβιου Πολυτεχνείου Γιώργο Γκαζέτα (σ.ε. νυν Πρόεδρο της ΕΕΕΕΓΜ) το Βραβείο Εξαίρετης Πανεπιστημιακής Διδασκαλίας.

Μέσα σε μια λαμπρή, όσο και συγκινητική ατμόσφαιρα, ο Γιώργος Γκαζέτας, παρέλαβε το Βραβείο από τα χέρια του Προέδρου της Ελληνικής Δημοκρατίας κ. Προκόπη Παυλόπουλου, την Παρασκευή 4 Δεκεμβρίου 2015.

Πρόκειται, για το Βραβείο Εξαίρετης Πανεπιστημιακής Διδασκαλίας «Βασίλη Ξανθόπουλου – Στέφανου Πνευματικού», το οποίο έχει θεσμοθετήσει από το 1991 το Ίδρυμα Τεχνολογίας και Έρευνας, στη μνήμη των λαμπρών Επιστημόνων του Πα-νεπιστημίου Κρήτης, Βασίλη Ξανθόπουλου και Στέφανου Πνευματικού, που δολοφονήθηκαν το βράδυ της 27ης Νοεμβρίου 1990 στο Ηράκλειο, τη στιγμή που επιτελούσαν από κοινού το διδακτικό λειτούργημα.

Ο Γιώργος Γκαζέτας, παρουσία του Αναπληρωτή Υπουργού Έρευνας και Καινοτομίας, του Πρύτανη του Ε.Μ.Π., βουλευτών αλλά και ενός πολυπληθούς ακροατηρίου από καταξιωμένους και διακεκριμένους επιστήμονες, παρέλαβε το Βραβείο και ευχαρίστησε θερμά για την μεγάλη τιμή που του έγινε, τόσο τον Πρόεδρο της Δημοκρατίας, όσο και την Επιτροπή Απονομής του Βραβείου, που απαρτίζεται από διακεκριμένους ακαδημαϊκούς, όπως, οι κ. Θεοδόσης Τάσιος (ΕΜΠ), Γιώργος Βέης (ΕΜΠ), Δημήτρης Παντερμαλής (ΑΠΘ), Αντώνης Μανιτάκης (ΑΠΘ), Αριστείδης Μπαλτάς (ΕΜΠ), Παναγιώτης Σουκάκος (ΕΚΠΑ), Βασίλειος Δουγαλής (ΕΚΠΑ) κ.α.

Για το έργο του τιμώμενου, ενός διεθνώς καταξιωμένου και διακεκριμένου επιστήμονα, αναφέρθηκε ο Ομότιμος Καθηγητής του Ε. Μ. Πολυτεχνείου κ. Θεοδόσης Τάσιος, ο οποίος εξήρε την αφοσίωση του Γιώργου Γκαζέτα στην πανεπιστημιακή διδασκαλία και αποκάλυψε πως η επιτροπή έλαβε πάνω από 50 επιστολές φοιτητών και συναδέλφων του με λεπτομερείς περιγραφές του διδακτικού του πάθους.

Έπαινος Βραβευομένου κ. Γ. Γκαζέτα

Εξοχότατε Κύριε Πρόεδρε της Ελληνικής Δημοκρατίας,

του αποψινού Επαίνου, ευλόγως χρειάζεται να προηγηθεί μια βραχύτατη υπόμνηση της βιογραφίας και της εργογραφίας του τιμωμένου.

Ο Γεώργιος Γκαζέτας ορμάται (κυρίως) εκ της κλεινής Τρίκκης (των Τρικάλων δηλαδή), έλαβε δε το Δίπλωμα του Πολιτικού Μηχανικού απ’ το γεραρόν Εθνικό Μετσόβιο Πολυτεχνείο, το 1973. Οι Μεταπτυχιακές-του σπουδές έγιναν στο M.I.T., απ’ όπου σύντομα έλαβε τον διδακτορικό-του τίτλο, το 1976. Στις ΗΠΑ ξεκίνησε μια σημαντική ακαδημαϊκή σταδιοδρομία: Επίκουρος Καθηγητής στο Case Western University, Αναπληρωτής Καθηγητής στο Renselaer Polytechnic Institute, Επισκέπτης Καθηγητής στο State University of New York – για να εκλεγεί (το 1982) Τακτικός Καθηγητής στην Έδρα της Εδαφομηχανικής στο Εθνικό Μετσόβιο Πολυτεχνείο. Αυτή η ταχεία αναγνώριση μέσα στο άκρως ανταγωνιστικό περιβάλλον των Η.Π.Α. (μέσα σε **πέντε μόνον χρόνια** απ’ την απόκτηση του διδακτορικού), προοιώνιζε την επιτυχή διεθνή σταδιοδρομία του Γεωργίου Γκαζέτα, η οποία θ’ ακολουθούσε **μετά** την εγκατάστασή-του στην Ελλάδα. Διότι εδώ μετριέται το πόσα απίδια έχει ο σάκκος – εδώ στο απομονωμένο (λένε), άφραγκο (ενίοτε δε και «παραξενιάρικο») περιβάλλον της κλεινής μας Χώρας. Ωστόσο, ο νεαρός (30-ούντης σχεδόν τότε Γκαζέτας), χάρις στην φιλόδοξη μακρόπνοη ερευνητική εκστρατεία που οργανώνει μέσα στο Πολυτεχνείο, αρχίζει να δρέπει απ’ τις επιστημονικώς σημαν--τικότερες Χώρες του Κόσμου διεθνή βραβεία και διακρίσεις:

Τα πρώτα χρόνια μετά την εγκατάστασή-του στην Ελλάδα, κερδίζει τρία αλλεπάλληλα βραβεία απ’ τη American Society of Civil Engineers. Ύστερα, δύο βραβεία απ’ τις Ινδίες (απ’ το Ερευνητικό Ινστιτούτο του μεγάλου εδαφομηχανικού Prakash). Ύστερα, ένα βραβείο απ’ την βρετανική Institution of Civil Engineers. Κατόπιν, διακρίσεις «Διακεκριμένου Ομιλητή» απ’ την Αγγλία, τη Γαλλία, και την Ιαπωνία – επανειλημμένως δέ.

Ποιό πρωτότυπο ερευνητικό έργο άραγε βρισκόταν πίσω απ’ αυτήν τη βροχή της διεθνούς αναγνώρισης;

Μέχρι σήμερα:

170 επιστ. εργασίες σε διεθνή περιοδικά κύρους
330 ανακοινώσεις σε Συνέδρια
25 βιβλία ή κεφάλαια βιβλίων

Και, το σπουδαιότερο, ο Γεώργιος Γκαζέτας έχει τιμηθεί με **8.000** ετεροαναφορές στη διεθνή βιβλιογραφία, ενώ χαρακ-τηρίζεται με την εμφανώς σπάνια τιμή του λεγόμενου “h-factor” ίση με 46. Να το ’πώ κι αυτό: Σε δέκα σημαντικά διεθνή εγχειρίδια Εδαφομηχανικής και Αντισεισμικής, έχουν περιληφθεί ατόφιες οι επιλύσεις προβλημάτων που έχουν προταθεί απ’ τον τιμώμενο. Μέσα στο Πολυτεχνείο έχει διδάξει 6 διαφορετικά μαθήματα και έχει παραγάγει μέχρι σήμερα 20 περίπου διδακτορικά, ενώ παράλληλα προσφέρει στην Τεχνολογία της Χώρας ποικίλες υπηρεσίες, ως Πρόεδρος Ελληνικών Επιστημονικών Ενώσεων, ως μέλος Επιτροπών σύνταξης Κανονισμών, ως οργανωτής πλήθους Σεμιναρίων, ως Εμπειρογνώμων-Διαιτητής σε διάφορα μεγάλα δημόσια έργα, αλλα και ως Μελετητής καινοτομικών λύσεων σε τεχνικά έργα στην Ελλάδα και το Εξωτερικό.

Ωστόσο, το βραβείο Εξαίρετης Πανεπιστημιακής Διδασκαλίας εις μνήμην Ξανθόπουλου-Πνευματικού, δέν βραβεύει την επιστημονική αριστεία των τιμωμένων καθεαυτήν. Προφανώς την προϋποθέτει – διοτι δέν νοείται πανεπιστημιακή διδασκαλία τύπου «μαγνητοφώνου» απλής μεταφοράς πληροφοριών˙ όχι βέβαια. Το βραβείο όμως απονέμεται με κύριο κριτήριο την ικανότητα και την αφιέρωση στην επιστημονική Διδακτική καθεαυτήν, στον βαθμό μάλιστα που επιτυγχάνει να δημιουργήσει Σχολή Διανόησης σπουδαίων Μαθητών που θ' ακολουθήσουν.

Ιδού λοιπόν τα αντίστοιχα προς αυτά τα κριτήρια δεδομένα, στα οποία στηρίχθηκε η παμψηφεί απόφαση της βράβευσης του κ. Γκαζέτα. Τα αρυσθήκαμε απ' το πλήθος των 50 περίπου επιστολών που δεχθήκαμε, με λεπτομερείς περιγραφές του διδακτικού **πάθους** του Γεωργίου Γκαζέτα, όπως το έζησαν παλαιότεροι και τωρινοί φοιτητές του. Με την άδειά-σας, θα ξεκινήσω απ' τις άμεσες διδακτικές ικανότητες τού τιμωμένου (υπενθυμίζοντας μάλιστα οτι, απ' την ετυμολογική του δομή, το ρήμα «διδάσκω» σημαίνει «καθιστώ τι αρεστόν» – καίρια υπενθύμιση νομίζω):

α) Ως γνωστόν, γέφυρα Παιδείας είναι το **Συναίσθημα** – έτσι μόνον θ' ανοίξει η καταπακτή της προσωπικότητας του μαθητή, μέσα σε μια αγαπητική (άρα κατα μέγιστον επικοινωνιακή) ατμόσφαιρα.

Κρίσεις Επιστολογράφων για τον τιμώμενο: «Δίνει την ψυχή του» (Μ.Μ.). «Με στήριξε, ενισχύοντας την αυτοπεποίθησή μου» (Α.Κ.). «Αγάπη και βαθειά αφοσίωση στους φοιτητές του», (Α.Ο.). «Συνδυάζει το μυαλό ενός παγκοσμίως αναγνωρισμένου επιστήμονα, με τη χαρά της συνεργασίας/επαφής με τους φοιτητές» (Μι.Μα.). «Διαθέσιμος όλες τις μέρες της βδομάδας και των διακοπών» (Α.Κ.)…

β) Η έκφραση του προς μετάδοση γνωσιακού αντικειμένου θα γίνει βέβαια μέσω της **Γλώσσας**. Μόνον έτσι δημιουργείται η προδιάθεση και η μετάθεση του μαθήματος απ' τον εγκέφαλο του Δασκάλου στον εγκέφαλο του Μαθητή. Η Γλώσσα είναι καίριος **μεσάζων παιδείας** – κι ας μή γίνει απόψε λόγος για την ανάγκη εμπειρικής απογραφής τού πού βρισκόμαστε εν προκειμένω. Ο Γεώργιος Γκαζέτας, όμως είναι γλωσσο-στοχαστής και γλωσσοχειριστής. Ενας ομότεχνος Συνάδελφος Καθηγητής γράφει: «Είναι ενας εργάτης της ελληνικής επιστημονικής γλώσσας με επιτυχίαν» (Κ.Π.). Κι ένας Μεταπτυχιακός παρατηρεί: «Προσφορά με τη σωστή χρήση της ελληνικής γλώσσας» (Κ.Α.).

γ) Η **μετακένωση γνώσεων** κατα την προπτυχιακή κυρίως διδασκαλία είναι φάση θεμελιώδης. Πρώτα θα διατεθεί μια πρώτη ύλη γνώσεων, παρούσα μέσα στη μνήμη του Μαθητή, κι ύστερα θα ασκηθεί μια κρίση. Και, φυσικά, ο Δάσκαλος πρέπει να τη διαθέτει γερά αυτήν τη γνώση – να του «ξεχειλίζει» όπως λέμε. Διοτι μια (κρυμμένη έστω) παπαγαλία απ' τον Δάσκαλο, θα γεννήσει παπαγαλία του Μαθητή. Θέλομε Δάσκαλο με **κορεσμό** γνώσεων.

Ο Γεώργιος Γκαζέτας φαίνεται πως έδινε αμέσως τη βεβαιότητα στον ακροατή οτι αυτά που λέει «τα έχει ζήσει»! Και λένε οι ακροατές:

«Είναι δάσκαλος μοναδικός» (Ε.Τ.). «Μοναδικό ταλέντο να εξηγεί δύσκολες έννοιες με εντελώς φυσικά παραδείγματα», (Α.Π.Τ.). «Εξαίρετος επιστήμονας» (Σ.Ε.). «Επιτυγχάνει την ακαδημαϊκή τελειότητα» (Α.Π.). «Εξαιρετικά υψηλό επιστημονικό επίπεδο, με αμεσότητα και ενθουσιασμό, τον οποίο έχει το χάρισμα να μεταφέρει στους Σπουδαστές» (Γ.Κ.).

δ) Πείρα και θεωρία αποδεικνύουν οτι η μετακένωση γνώσεων επιταχύνεται μεγάλως εάν ο Μαθητής οδηγηθεί σταδιακώς απ' τον Δάσκαλο να ανακαλύπτει ξανά **μόνος του** τη διαθέσιμη γνώση, μέσω κατάλληλης **μαιευτικής**. Έτσι, και η μνήμη ενισχύεται, και η κριτική στάση ενθαρρύνεται – αλλα και πρόσθετα κίνητρα διανοητικής **ικανοποίησης** έχει ο Μαθητής.

Λοιπόν, οι προτείναντες την υποψηφιότητα του Γεωργίου Γκαζέτα για το βραβείο, περιγράφοντας τον τρόπο της διδασκαλίας-του, αναφέρουν οτι μέσω ερωτήσεων σταδιακώς αυξανόμενης δυσκολίας, κάνει τους διδασκόμενους «να αισθάνονται οτι οδηγήθηκαν μόνοι-τους στη λύση». Ένας δε παλιός-του Μεταπτυχιακός παρατηρεί οτι «μας ωθούσε να ***παράξουμε*** τη γνώση, βασισμένοι σε όσα ήδη ξέραμε», (Α.Ο.).

ε) Ωστόσο, η πανεπιστημιακή διδασκαλία σκοπεί καιρίως και στην ανάπτυξη του **κριτικού πνεύματος**: Ο επιστήμονας δέν είναι «αποθηκευτής» γνώσεων˙ πρέπει να διακρίνει όποια σφάλματα (δικά-του ή των άλλων), μιάς κι η Επιστήμη ειναι Ανα-κάλυψη, δέν είναι Από-κάλυψη. Η δέ ανάπτυξη του κριτικού πνεύματος είναι διδακτικώς δυσχερέστατη – δέν είναι απλή «μετακένωση» γνώσεων!

Οι Μαθητές του Γεωργίου Γκαζέτα, του αναγνωρίζουν αυτήν την ειδική ικανότητα: «Κάθε διάλεξή-του ήταν μια προσφορά […] αναφορικά με […] την ανάπτυξη της κριτικής-μας σκέψης», (Κ.Α.). «Η καλλιέργεια της κριτικής ικανότητας αποτελεί πρωταρχικό σκοπό της διδασκαλίας του, καθώς αποζητά συνεχώς τη διατύπωση απoριών και διαφωνιών» (Προτείναντες).

στ) Η ανάπτυξη **ερευνητικού πνεύματος** τώρα, είναι απ' τα ακόμα πιό δύσκολα και χρονοβόρα εκπαιδευτικά αιτήματα – και μάλιστα μέσα σ' εναν περίγυρο των Σχολείων μας που δέν διαθέτει πάντοτε τα χαρακτηριστικά ενος Κολλεγίου του Κέημπριτζ…. Η παραγωγή νέας επιστημονικής γνώσης απαιτεί την επιστράτευση πρόσθετων διανοητικών και συναισθηματικών μηχανισμών – όπως βαθειά κατανόηση, συνδυαστική φαντασία, έλεγχοι και εμμονή. Κι όλα τούτα «διδάσκονται» μόνον μέσω Μαθητείας δίπλα σ' εναν Ερευνητή - Δάσκαλο - ενθαρρυντή και συμπορευτή.

Στον τομέα αυτόν, φαίνεται οτι ο τιμώμενος διαθέτει τάλαντον παραγωγής Ερευνητών: "He has an extraordinary enthusiasm in research and the capacity to transfer it to the co-workers and the Students", (S.L.), λέει ενας ξένος Καθηγητής. Κι ενας Έλληνας Καθηγητής προσθέτει: «Ο Γεώργιος Γκαζέτας κινητοποιεί τους καλύτερους φοιτητές για ερευνητική ενασχόληση», (Χ.Γ.). Ένας δε παλιός μεταπτυχιακός-του, ερευνητής σήμερα στις Η.Π.Α., γράφει: «Μου μετέδωσε το πάθος-του για την έρευνα», (Π.Γ.). Κι ενας Έλληνας Καθηγητής προσθέτει: «Ο συνάδελφος Γεώργιος Γκαζέτας […] παθιάζεται και μεταφέρει αυτό-του το δημιουργικό πάθος στους φοιτητές του», (Κ.Π.).

ζ) Αλλα για να ανατροφοδοτούνται τα προηγούμενα συστατικά της πανεπιστημιακής Διδακτικής, απαιτείται κι η ανάπτυξη ενός μόνιμου πλαισίου **συλλογικής** καλλιέργειας της Επιστήμης. Είναι αυτό που ονομάζομε στην Επιτροπή-μας ***«δημιουργία Σχολής».***

Στο θέμα αυτό φαίνεται οτι ο Γεώργιος Γκαζέτας αριστεύει: Το επιβεβαιώνουν οι πρώην Μαθητές-του νύν Καθηγητές Πανεπιστημίων στο Βόλο, στην Πάτρα, στο ΕΜΠ, στο Dundee, στο Caltech και στο Berkeley. Ενώ μια άλλη Καθηγήτρια γράφει στην Επιτροπή-μας: «Θεωρώ οτι η δημιουργία μιας Ομάδας, με γνώση και με αγάπη για την Έρευνα και τη Διδασκαλία, αποτελεί μιά απ' τις σημαντικότερες συμβολές του Ερευνητή και Δασκάλου Γεωργίου Γκαζέτα» (Ε.Κ.).

Η (τόσο σημαντική για το Σύνολο) περιπέτεια ενος άξιου πανεπιστημιακού Δασκάλου, έχει ίσως κι άλλο ένα πιθανό αποτέλεσμα: Η **ζωή** ενος τέτοιου εμβληματικού προσώπου, ενδέχεται να γίνει **παράδειγμα** για άλλους (λέμε τώρα) – κι όχι μόνον στην Επιστήμη αλλά στον **βίο** εγγένει. Γι' αυτό και η προκήρυξη του παρόντος βραβείου αναφέρεται και σε δραστηριότητες του Δασκάλου που καθιστούν τον Φοιτητή «κοινωνόν τού επιστημονικού **ήθους** και της ανιδιοτελούς αναζήτησης της αληθείας». Όσον μεγαλορρήμονες κι άν ακούγονται αυτοί οι λόγοι, πολλοί απο μάς έχομε την πεποίθηση οτι συνιστούν προϋπόθεση του συμφέροντος του Λαού μας.

Κι ο Γκαζέτας, εν προκειμένω;

Δύσκολο να τεκμηριωθούν τέτοιας κατηγορίας ιδιότητες του Δασκάλου. Ωστόσο, στην Επιτροπή-μας έφθασαν και τέτοιες ενδείξεις για τον Γκαζέτα: Πώς λ.χ. όταν βρισκόταν στο ανταγωνιστικό Μ.Ι.Τ., αφιέρωνε φροντίδες και χρόνον πολύν για να συμπαραστέκεται σε μια συμφοιτήτρια που υπέφερε απο σχιζοφρένεια (Σ.Τραχ.). Ή πώς αργότερα ως Καθηγητής τηλεφωνούσε προσωπικώς στα σπίτια των φοιτητών για να ρωτάει «πώς σας φάνηκε η εκπαιδευτική εκδρομή;» (Γ.Χ.). Κι ενας άλλος φοιτητής διερωτάται: «Τί απλότητα και τί μετριοφροσύνη – σπουδαίος άνθρωπος» (Γε.Κα.). Κι ενας άλλος ακόμη: «Εξαίρετος επιστήμων, παράδειγμα προς μίμηση. Κι ενας υπέροχος άνθρωπος, γεμάτος αισιοδοξία και χαμόγελο – πράγμα που ως φοιτητής-του με έκανε να βλέπω τα προβλήματα με μια τελείως διαφορετική οπτική γωνία. Αυτό κι αν αποτελεί παράδειγμα», λέει (Π.Σ.). Και μια άλλη φοιτήτρια: «Το όνομά-του είναι ήδη συνδεδεμένο με υπόδειγμα», (Χ.Π.). Και κάτι άλλο (εξαιρετικά ουσιώδες κατα την άποψή μας): «Όταν είχαμε καταλήψεις, έψαχνε μόνος του για αίθουσα, για να μή χαθεί το μάθημα», (Π.Κα). Κι αντιλαμβάνομαι οτι, σε 'κείνες τις ώρες της απέραντης σύγχυσης, δέν χρειαζόταν μόνον η ευρηματικότητα τόπων αλλα και κάποια γενναία πεποίθηση περι του πραγματικού συμφέροντος του Λαού μας. Φαίνεται λοιπόν οτι έχομε εδώ να κάνομε με μια ευρύτερα «εξαίρετη» διδασκαλία – μια διδασκαλία **βιοτροπίας**. Κι επαληθεύεται αυτή η εντύπωση κι απ' το διεθνές παράδειγμα διδακτικής αφοσίωσης που δίνει ο Γεώργιος Γκαζέτας μέσω του θεσμού της ετήσιας, άκρως απαιτητικής, εκπαιδευτικής εκδρομής που οργανώνει στο Kobe της Ιαπωνίας – θεσμός-παράδειγμα τον οποίον ακολουθούν ήδη στην Ιαπωνία (καθηγητής Takashi Tazoh, επιστολή 16.01. 2015) και στο Northwestern University των Η.Π.Α. (Καθ. M.K. Yegian, επιστολή 08.04.2015).

Αυτόν τον Δάσκαλο τιμούμε απόψε Εξοχότατε Κύριε Πρόεδρε της Ελληνικής Δημοκρατίας.

Θ.Π. Τάσιος

Σύντομο Βιογραφικό Σημείωμα Γιώργου Γκαζέτα

Ο Γιώργος Γκαζέτας είναι Καθηγητής στην Σχολή Πολιτικών Μηχανικών του Εθνικού Μετσοβίου Πολυτεχνείου (ΕΜΠ). Απόφοιτος της ιδίας Σχολής, είναι διδάκτωρ του Τεχνολογικού Ινστιτούτου Μασσαχουσσέτης (ΜΙΤ). Το 1982 εξελέγη τακτικός Καθηγητής στο ΕΜΠ, όπου επί 30 σχεδόν χρόνια διδάσκει κλασσική και σεισμική εδαφομηχανική – θεμελιώσεις. Εχει διδάξει επίσης ως καθηγητής (διαφόρων βαθμίδων) σε τρία αμερικανικά Πανεπιστήμια και έχει δώσει πολυήμερα σεμινάρια σε Ευρωπαϊκά Πανεπιστήμια και σε Ιαπωνικά ερευνητικά Ινστιτούτα.

Το ερευνητικό έργο του καλύπτει ευρύ φάσμα της γεωτεχνικής και σεισμικής μηχανικής, με έμφαση στην εφαρμογή της κυματικής σε σύνθετα προβλήματα δυναμικής αλληλεπίδρασης συστημάτων εδάφους–θεμελίου–κατασκευής, στην επινόηση φυσικής–εμπνεύσεως απλοποιημένων μεθόδων αντισεισμικού υπολογισμού, και στην μετασεισμική διερεύνηση αστοχιών με στόχο την εξειχνίαση παράδοξων συμπεριφορών. Θεωρεί ωστόσο την μεγαλύτερη συμβολή του στην ελληνική επιστήμη–τεχνολογία την συστηματική εφαρμογή των ερευνητικών του επιτευγμάτων σε πραγματικά έργα πολιτικού μηχανικού (φράγματα, γέφυρες, λιμάνια, κατασκευές), και την προσαρμογή–μεταφορά της εμπειρίας του αυτής στην διδασκαλία. Υπήρξε μέλος των συγγραφικών ομάδων των αντισεισμικών κανονισμών στην Ελλάδα (ΕΑΚ), Ευρώπη (EC8) και ΗΠΑ (NEHRP).

Για το ερευνητικό του έργο έχει λάβει πολυάριθμα διεθνή βραβεία από τις ΗΠΑ, Βρεττανία, Γαλλία, Ιαπωνία, Ινδία, Νέα Ζηλανδία, καθώς και την Διεθνή Επιστημονική Επιτροπή Εδαφομηχανικής. Αναφέρονται : το βραβείο Alfred Noble από κοινού από 5 Τεχνικά Επιμελητήρια των ΗΠΑ, τα βραβεία Huber και Croes (του Συλλόγου Πολιτικών Μηχανικών των ΗΠΑ) και ISET-SP (του Συλλόγου Αντισεισμικών Μηχανικών της Ινδίας). Υπήρξε ο επίλεκτος ομιλητής των προβεβλημένων διαλέξεων "Coulomb" (2009) και "Ishihara" (2013), και ο κεντρικός ομιλητής σε άνω των 50 παγκοσμίων και ελληνικών συνεδρίων. Πολύ πιο υπερήφανος όμως είναι για τους πολυάριθμους «διπλωματικούς» και «διδακτορικούς» φοιτητές του που τώρα διαπρέπουν στον ακαδημαϊκό και επαγγελματικό στίβο.

ΕΛΛΗΝΙΚΕΣ ΤΕΧΝΟΛΟΓΙΚΕΣ ΕΞΕΛΙΞΕΙΣ ΣΤΗΝ ΓΕΩΜΗΧΑΝΙΚΗ

"SYMMETRIC"
ΜΙΑ ΝΕΑ ΠΡΟΣΕΓΓΙΣΗ ΔΙΑΧΕΙΡΙΣΗΣ ΕΡΕΥΝΗΤΙΚΩΝ ΓΕΩΤΡΗΣΕΩΝ

Η εταιρεία "**Κ&Α ΕΠΙΜΕΤΡΟΝ Ε.Π.Ε.**", λαμβάνοντας υπόψη τις σύγχρονες απαιτήσεις της αγοράς, σχετικά με την έρευνα του υπεδάφους και την Διαχείριση των Ερευνητικών Γεωτρήσεων, ανάπτυξε μια καινοτόμα Υπηρεσία Cloud Computing με την επωνυμία "**Symmetric**", η οποία διατίθεται στην ιστοσελίδα της εταιρείας www.epimetron.com.

Το "**Symmetric**" αποτελεί την μοναδική έως σήμερα, Υπηρεσία Καταχώρησης, Επεξεργασίας και Διαχείρισης Δεδομένων Ερευνητικών Γεωτρήσεων Υπεδάφους, σε πραγματικό χρόνο, με χρήση Internet, προσφέροντας στους χρήστες της τα ακόλουθα πλεονεκτήματα:

- Ολιστική αντιμετώπιση του αντικειμένου των ερευνητικών γεωτρήσεων σχετικά με: α) τις εργασίες πεδίου και την χρονική παρακολούθησή τους, β) τη διαχείριση του προσωπικού και των μηχανημάτων και γ) την δημιουργία αναφορών (Μητρώο Γεώτρησης, ημερολόγιο έργου, αναφορές προόδου, υπομνημάτων κ.α.).
- Ασφάλεια χρήσης δεδομένων και υιοθέτησης ρόλων με διαφορετικά δικαιώματα - Πολυπαραγοντική Διαχείριση.
- Δημιουργία ενοποιημένου περιβάλλοντος χρήσης και Βάσης Δεδομένων.
- Άμεση πρόσβαση των χρηστών στα δεδομένα των ερευνών από οπουδήποτε και οποτεδήποτε.

Τα ανωτέρω πλεονεκτήματα παρέχουν σαφή πλεονεκτήματα απέναντι στον ανταγωνισμό διότι με την χρήσης της Υπηρεσίας "**Symmetric**", επιτυγχάνεται:

- Η βέλτιστη δυνατή παρακολούθηση και διαχείριση των πολλαπλών εργασιών πεδίου
- Η τυποποίηση της πληροφορίας και η ελαχιστοποίηση των λαθών καταχώρησης
- Πολύ σημαντική εξοικονόμηση του χρόνου παραγωγής των απαραίτητων αναφορών
- Η ανάπτυξη ισχυρής συνεργασιμότητας σε ενιαίο περιβάλλον χρήσης.
- Η αέναη χρήση και διαχείριση του συνόλου της πληροφορίας των Ερευνητικών γεωτρήσεων.

Η Υπηρεσία "**Symmetric**", απευθύνεται τόσο σε μεμονωμένους χρήστες που ασχολούνται με τον χώρο των Ερευνητικών γεωτρήσεων, όπως Γεωλόγους, Γεωτεχνικούς Μηχανικούς, Μεταλλειολόγους Μηχανικούς κ.ά., όσο και σε ιδιωτικές εργοληπτικές και μελετητικές εταιρείες και δημόσιους κρατικούς φορείς που διαχειρίζονται μεγάλου όγκου ερευνητικά δεδομένα.

Η Υπηρεσία "**Symmetric**" αποτελεί μία νέα προσέγγιση που απλοποιεί και ενοποιεί την Διαχείριση Δεδομένων Ερευνητικών Γεωτρήσεων. Φιλοδοξεί να δώσει μία συνολική λύση σε μία σειρά από χρόνιες υφιστάμενες προκλήσεις και προβλήματα που υπάρχουν στον χώρο.

Προκλήσεις και προβλήματα

Ο χώρος των Ερευνητικών Γεωτρήσεων χαρακτηρίζεται εδώ και χρόνια από μία σειρά σημαντικών προκλήσεων:

- Τα δεδομένα είναι μεγάλου όγκου και απαιτούν ακρίβεια και πολύπλευρη επεξεργασία.
- Η σωστή καταχώρηση των δεδομένων προϋποθέτει επιστημονική επάρκεια, επαγγελματική εμπειρία και ελαχιστοποίηση λαθών.
- Απαιτείται η τήρηση Διεθνών Προδιαγραφών και Προτύπων καθώς επίσης και η θέσπιση κανόνων Τυποποίησης.
- Τα έργα των Ερευνητικών Γεωτρήσεων περιλαμβάνουν ένα σύνολο χρονοβόρων εργασιών, ιδιαίτερου κόστους και συνεπώς η άμεση επιμέτρησή τους προσφέρει σημαντικό οικονομοτεχνικό πλεονέκτημα.
- Υπάρχει η ανάγκη άμεσης γνωστοποίησης πληροφοριών προς πολλούς αποδέκτες.
- Τα έργα απασχολούν πολυάριθμο επιστημονικό και τεχνικό προσωπικό καθώς και σημαντικό αριθμό μηχανημάτων, για τα οποία απαιτείται η ημερήσια παρακολούθηση της πορείας των εργασιών τους.

Περιορισμοί ανταγωνιστικών προϊόντων

Τα ανταγωνιστικά προϊόντα που υπάρχουν στην αγορά χαρακτηρίζονται από τα ακόλουθα μειονεκτήματα :

- Προβλήματα και αστοχίες στον έλεγχο και στην εγκυροποίηση των δεδομένων.
- Αποσπασματική αντιμετώπιση των αναγκών του χώρου.
- Παρουσιάζουν δυσκολίες στην τυποποιημένη συλλογή πληροφοριών απευθείας σε Βάσεις Δεδομένων.
- Αποδίδουν μικρή σημασία στην ανάγκη ομαδικής εργασίας επάνω στα ίδια δεδομένα.
- Μειονεκτούν στην απλότητα και στην φιλικότητα ως προς τον χρήστη.
- Τα παραγόμενα αρχεία τους, δεν έχουν μεγάλη ακρίβεια και συνήθως δεν είναι σε επεξεργάσιμη μορφή.
- Δειλά βήματα στην υιοθέτηση των δυνατοτήτων των νέων τεχνολογιών και του Internet.

Μια νέα προσέγγιση - "Symmetric"

Η Υπηρεσία "**Symmetric**"είναι μία πλατφόρμα Διαχείρισης Ερευνητικών Γεωτρήσεων η οποία:

- Ενοποιεί και απλοποιεί τον τρόπο εργασίας.

- Παρέχει ισχυρούς ελέγχους και αυτοματοποιήσεις την ώρα που γίνεται η καταχώρηση.
- Εισάγει άμεσα τα ελεγμένα δεδομένα σε κατάλληλη Βάση Δεδομένων.
- Επιτρέπει την ταυτόχρονη εργασία ομάδων χρηστών.
- Διαχειρίζεται απαραίτητα δεδομένα προσωπικού και μηχανημάτων.
- Τυποποιεί, ομαδοποιεί και επιμετρά άμεσα τις γεωτεχνικές εργασίες.
- Χρησιμοποιεί τα γνωστότερα συστήματα (SI, US) και τις μονάδες τους.
- Παράγει με μεγάλη ακρίβεια και ταχύτητα απαραίτητα αρχεία και αναφορές ως επεξεργάσιμα αρχεία Excel.
- Έχει φιλικό περιβάλλον με την χρήση ενός απλού browser.
- Δίνει έμφαση στην ασφάλεια των δεδομένων.
- Είναι προσβάσιμη από οπουδήποτε και οποτεδήποτε μέσω Internet.
- Χρησιμοποιεί τις δυνατότητες σύγχρονού λογισμικού, τεχνολογιών αιχμής και την δύναμη του Cloud Computing.
- Έχει μεγάλες δυνατότητες διαλειτουργικότητας και επικοινωνίας με ετερογενείς πηγές δεδομένων.
- Έχει αρθρωτή και επεκτάσιμη αρχιτεκτονική που του επιτρέπουν την επέκταση προς συναφή πεδία (Υδρογεωτρήσεις, Jet grouting, Αποκλισιόμετρα κ.α).

Χαρακτηριστικά

Η υπηρεσία "**Symmetric**", διαθέτει μοναδικά χαρακτηριστικά, τα οποία συνοπτικά είναι τα ακόλουθα:

- Καταχώρηση και επεξεργασία σε ημερήσια βάση, του συνόλου των δεδομένων της γεωτρητικής έρευνας (στοιχεία διάτρησης, γεωλογικές περιγραφές, περιγραφή ασυνεχειών, επί τόπου δοκιμές, δοκιμές διαπερατότητας κ.α.). Με βάση τα στοιχεία που καταχωρούνται, δημιουργούνται Μητρώα γεωτρήσεων σε πραγματικό χρόνο.
- Καταχώρηση και επεξεργασία ποσοτήτων εργαστηριακών δοκιμών α) κατάταξης, β) προσδιορισμού μηχανικών παραμέτρων, εδαφομηχανικής και γ) βραχομηχανικής.
- Διαχείριση του Προσωπικού και των Μηχανημάτων που απασχολούνται σε ένα έργο ερευνητικών γεωτρήσεων. Καταγραφή ωρών εργασίας και απασχόλησης και δυνατότητα δημιουργίας σύνθετων παραμετρικών αναφορών ανά έργο, κατηγορία Προσωπικού, τύπο Μηχανημάτων. Επίσης υπάρχει η δυνατότητα δημιουργίας αναφορών Προόδου.
- Τα δεδομένα καταχωρούνται και επεξεργάζονται σε Ελληνικές ή και Αγγλικές φόρμες και αναφορές, ενώ ο χρήστης έχει επιπρόσθετα και την δυνατότητα επιλογής του μετρικού συστήματος.
- Αυτοματοποιημένοι έλεγχοι και πληθώρα εργαλείων πλοήγησης, εντός της ιστοσελίδας, ώστε να την καθιστά την χρήση της ιδιαίτερα απλή, αποφεύγοντας λάθη διπλό-εγγραφών.

Τα ανωτέρω χαρακτηριστικά διαφοροποιούνται αναλόγως του ρόλο που έχει καθοριστεί για τον χρήστη της Υπηρεσίας. Έχουν υιοθετηθεί, με διαφορετικά δικαιώματα, ο ρόλος του Διαχειριστή, Καταχωρητή και του Επισκέπτη.

Επιπρόσθετα, οι χρήστες έχουν την δυνατότητα χρησιμοποίησης της πλατφόρμας για λόγους επικοινωνούν μεταξύ τους.

Οι αναφορές που δημιουργούνται από την Υπηρεσία **"Symmetric"**, είναι σε επεξεργάσιμη μορφή (Excel), ενώ προβλέπεται η δυνατότητα δημιουργίας ακόμα περισσότερων πρότυπων αναφορών.

Η καταχώρηση και η επεξεργασία των Δεδομένων μπορεί να πραγματοποιηθεί με χρήση υπηρεσιών Internet από οπουδήποτε και οποτεδήποτε, χαρακτηριστικό μοναδικό, απέναντι στον ανταγωνισμό και ιδιαίτερα χρήσιμο σε έργα μεγάλης κλίμακας, όπου συμμετάσχει σημαντικός αριθμός εμπλεκομένων ενδεχόμενα και σε διαφορετικές χώρες μεταξύ τους.

Η υπηρεσία βασίζεται στην επιτυχημένη προγραμματιστική πλατφόρμα Microsoft .NET, ενώ ο διακομιστής βάσης δεδομένων (RDBMS) είναι ο SQL Server 2012. Αξιοποιεί τις δυνατότητες της τελευταίας έκδοσης .NET 4.5 και ιδιαίτερα εκείνου του μέρους των προγραμματιστικών λειτουργιών που αφορά σε web περιβάλλοντα και καλείται ASP.NET, ενώ έχει γραφτεί στη γλώσσα προγραμματισμού που ονομάζεται C# .NET

(Σημείωση Εκδότη: Η παραπάνω καταχώρηση είναι σαφώς διαφημιστική. Διαφημίζει, όμως, ένα πρωτοποριακό προϊόν, δημιουργημένο από Έλληνες γεωτεχνικούς επιστήμονες, το οποίο αξίζει να το προβάλουμε.)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

12th ISRM online lecture by Prof. Ove Stephansson is now online

For the 12th ISRM Online Lecture the ISRM invited Professor Ove Stephansson and the title is "Rock Stress and Stress Fields". The lecture was broadcast on 12 November and remains available in a dedicated webpage (https://www.isrm.net/gca/?id=1104).

Ove Stephansson was born in the old mining town of Falun Sweden. Since his retirement in 2002 as Emeritus Professor at The Royal Institute of Technology KTH in Stockholm he lives in Berlin. Presently, he's a Visiting Professor at GFZ German Research Centre for Geosciences in Potsdam Germany and belongs to the Section for Seismic Hazard and Stress Field. All his academic degrees are from University of Uppsala in Sweden. His PhD was about rock mechanics and theoretical and experimental structural geology and was supervised by Prof. Hans Ramberg.

In 1974 he was appointed professor of rock mechanics at Luleå Technical University and during 16 years taught Rock Mechanics for mining students and developed rock mechanics and its laboratory at the University in Luleå. From 1991 to retirement he taught Engineering Geology to the civil engineers at KTH in Stockholm.

He is the co-author of two textbooks on rock stress and rock stress measurements. The first about measuring rock stress together with Bernard Amadei at University of Colorado Boulder, the second about the stress field of the Earth's crust together with Arno Zang at GFZ. Other areas of expertise are characterization of rock joints, mathematical modelling and geological disposal of spent nuclear fuel and radioactive waste.

Prof. Stephansson's time with ISRM goes back to 1966 when he attended the 1st ISRM Congress in Lisbon. In 1991-1995 he served as ISRM Vice president for Europe and over the years worked for several ISRM Commissions including the Commissions on Rock Joints, Testing Methods, Design Methodology, Crustal Stress and Earthquakes. He is an ISRM Fellow since 2013.

Previous ISRM Online Lectures were given by Prof. Wulf Schubert, Prof. John Hudson Dr. Pierre Dufaut, Prof. Eduardo Alonso, Dr John Read, Prof. Herbert Einstein, Prof. Shunsuke Sakurai, Prof. Resat Ulusay, Prof. Dick Stacey, Prof. Jean Sulem and Dr. Nick Barton. All the ISRM Online Lectures remain available on the ISRM website in a dedicated webpage.

ITA just released the video presenting tunnelling activities all over the world in 2015

This video presents the major tunnelling works in progress in 2015 as well as some future projects:

https://www.youtube.com/watch?v=pxTW0dGskOM&feature=share

ΑΝΑΣΚΟΠΗΣΗ ΓΕΓΟΝΟΤΩΝ ΓΕΩΤΕΧΝΙΚΟΥ ΕΝΔΙΑΦΕΡΟΝΤΟΣ ΣΤΗΝ ΕΛΛΑΔΑ

Ελληνική Επιτροπή Σηράγγων και Υπογείων Έργων (Ε.Ε.Σ.Υ.Ε.)
Διάλεξη Giulia Viggiani

Τη Δευτέρα 30 Νοεμβρίου παρουσιάσθηκε στην αίθουσα εκδηλώσεων της Πρυτανείας του ΕΜΠ η διάλεξη της Giulia Viggiani, καθηγήτριας στο Πολυτεχνείο Tor Vergata της Ρώμης με θέμα: Evaluating the effects of tunnelling on historical buildings: the example of Line C of Roma underground. Στο ακόλουθο link μπορείτε να παρακολουθήσετε την διάλεξη.

https://www.youtube.com/watch?v=XiuMFPQFWhQ

Το Τεχνικό Επιμελητήριο Ελλάδος / Περιφερειακό Τμήμα Κεντρικής Μακεδονίας διοργάνωσε, την 7η Δεκεμβρίου 2015, ημερίδα με τίτλο «ΚΑΤΟΛΙΣΘΗΤΙΚΑ ΦΑΙΝΟΜΕΝΑ: ΕΚΔΗΛΩΣΗ – ΠΑΡΑΚΟΛΟΥΘΗΣΗ – ΑΝΤΙΜΕΤΩΠΙΣΗ».

Στόχος της ημερίδας ήταν να ενημερωθεί το ευρύ τεχνικό κοινό για τις τρέχουσες εξελίξεις σε θέματα που αφορούν τις κατολισθήσεις και μέσα από πραγματικά παραδείγματα να εξοικειωθεί με περιπτώσεις ενόργανης παρακολούθησης καθώς και μέτρα αντιμετώπισής τους και αποκατάστασης.

Η ημερίδα συγκέντρωσε εργασίες από πραγματικές κατολισθήσεις που εκδηλώθηκαν στην περιοχή της Βορείου Ελλάδος και των Ιονίων Νήσων, επικεντρωμένες στην ενόργανη παρακολούθηση του φαινομένου και στα μέτρα αντιμετώπισής τους όπως φαίνεται παρακάτω:

«Μέτρα αντιμετώπισης Κατολισθήσεων. Η χρήση των πασσάλων- Νεότερες εξελίξεις».

Χρ. Αναγνωστόπουλος Καθ. Γεωτεχν. Μηχανικής, ΑΠΘ

«Διαχείριση αβεβαιότητας στην αντιμετώπιση των κατολισθήσεων»

Στ. Τσότσος Ομότ. Καθ. Γεωτεχν. Μηχανικής, ΑΠΘ

«Εκτίμηση κατολισθητικής επικινδυνότητας σε περιφερειακή και τοπική κλίμακα»

Ν. Κλήμης Αν. Καθ. Γεωτεχν. Τομέα, ΔΠΘ

Διάλειμμα

«Διαχείριση κινδύνου κατολισθήσεων κατά μήκος οδικών αξόνων. Εφαρμογή στην επαρχιακή οδό Σερρών-Λαϊλιά»

Θ. Παπαλιάγκας Καθ. Αλεξάνδρειου ΤΕΙ Θεσ/νίκης

«Κατολισθητικά Φαινόμενα σε περιοχές της Περιφέρειας Κεντρικής Μακεδονίας - Διερεύνηση των συνθηκών εκδήλωσής τους και μέτρα Αποκατάστασης»

Δ. Καραμπατάκης Δρ. ΠΜ

«Αστοχίες τεχνητών πρανών-επιχωμάτων και τοίχων αντιστήριξης από σεισμούς στα Ιόνια Νησιά-Επιπτώσεις στο οδικό δίκτυο»

Κ. Μάκρα Ερευν. ΟΑΣΠ-ΙΤΣΑΚ
Μ. Ροβίθης Ερευν. ΟΑΣΠ-ΙΤΣΑΚ

«Κατολισθητικά φαινόμενα στην Εγνατία οδό: διάγνωση, αντιμετώπιση, παρακολούθηση»

Ε. Σακουμπέντα ΠΜ Εγνατία Οδός Α.Ε
Μ. Χαραλαμπάκης ΠΜ Εγνατία Οδός Α.Ε.

«Κατολισθητικά Φαινόμενα στην περιοχή Κ. Σχολαρίου της Περιφέρειας Κεντρικής Μακεδονίας - Διερεύνηση των συνθηκών εκδήλωσής τους και μέτρα αποκατάστασης»

Ν. Καζίλης, Τ. Γεωλόγος, MSc
Χ. Παπαδόπουλος, ΠΜ, MSc
Θ. Παπαδόπουλος, Δήμαρχος Θέρμης

Θεματικές παρεμβάσεις από Τ. Αυτοδιοίκηση και άλλους φορείς - συζήτηση

ΔΙΑΡΚΗΣ ΟΜΑΔΑ ΕΡΓΑΣΙΑΣ ΤΕΕ/ΤΚΜ ΑΝΤΙΜΕΤΩΠΙΣΗΣ ΦΥΣΙΚΩΝ & ΤΕΧΝΟΛΟΓΙΚΩΝ ΚΑΤΑΣΤΡΟΦΩΝ ΣΤΟ ΑΣΤΙΚΟ ΠΕΡΙΒΑΛΛΟΝ

ΠΡΟΣΦΟΡΑ ΕΡΓΑΣΙΑΣ

Chef d'Aménagement pour un transfert hydraulique en tunnel

Πολιτικός Μηχανικός για επί τόπου Διεύθυνση Επίβλεψης κατασκευής υδραυλικής σήραγγας στην Αλγερία κοντά στην πόλη Κωνσταντίνη. Ο ενδιαφερόμενος πρέπει να έχει εμπειρία τουλάχιστον 20 χρόνια στον τομέα των μεγάλων υδραυλικών έργων, καθώς και επίβλεψης τουλάχιστον ενός έργου μεταφοράς και μίας σήραγγας. Απαραίτητα: άριστη γνώση γαλλικών, χρήση Η/Υ, δίπλωμα οδήγησης. Ασφαλές περιβάλλον, πολύ καλές συνθήκες διαμονής-αυτοκίνητο-ασφάλιση. Αποστολή βιογραφικού σημειώματος στα γαλλικά: Ibensasson@enm.gr και gdoulis@edafomichaniki.gr με την ένδειξη AL.08_CA.

Position : Chef d'Aménagement pour un transfert hydraulique en tunnel

Localisation: Algérie Est - au chantier du projet.

MISSION

Seconder le Directeur de Projet du Client dans la gestion technique, administrative et financière du projet.

Avoir la diligence et la compétence nécessaire pour résoudre les problèmes techniques du chantier de manière à ne pas perturber l'avancement planifié des travaux.

Veiller à l'application du contrat, au respect de la planification des travaux de réalisation et à l'économie du projet.

PROFIL ET COMPETENCES

√ Ingénieur diplômé spécialisé dans le Génie-Civil

√ Expérience d'au moins 20 ans dans le domaine des grands projets hydrauliques

√ Ayant dirigé au moins les travaux d'un transfert et d'un tunnel en souterrain

√ Maitrise du français tant à l'oral qu'à l'écrit est impérative

√ Maitrise des outils informatiques

√ Permis de conduire valide

√ Expérience en Afrique du Nord un atout

AVANTAGES DU POSTE

√ Logement meublé et équipé au chantier

√ Voiture

√ Assurance

Si vous avez de l'intérêt pour ce poste on vous invite à faire parvenir votre CV à l'adresse mail@enb.gr ou gdoulis@edafomichaniki.gr avec la mention AL.08_CA

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

Για τις παλαιότερες καταχωρήσεις περισσότερες πληροφορίες μπορούν να αναζητηθούν στα προηγούμενα τεύχη του «περιοδικού» και στις παρατιθέμενες ιστοσελίδες.

GROUND ENGINEERING INSTRUMENTATION AND MONITORING 2016

15-16 March 2016, London, United Kingdom
https://monitoring.geplus.co.uk/

Explore the strategies and technologies required to safely and efficiently deliver projects.

Ground Engineering's seventh annual Instrumentation and Monitoring conference will give you the insight required to improve how you specify, procure and use monitoring data as well as making the connections to win future work. As the industry moves towards the next generation of projects, ensuring you have the knowledge of the latest practices and techniques will prove more and more essential as the sector continues to develop.

Customer Services: 020 3033 2609, Ilja.Ryndin@EMAP.com

GeoAmericas 2016 3rd Panamerican Conference on Geosynthetics, 11 – 14 April 2016, Miami Beach, USA, www.geoamericas2016.org

International Symposium on Submerged Floating Tunnels and Underwater Structures (SUFTUS-2016), 20-22 April 2016, Chongqing, China, www.cmct.cn/suftus

World Tunnel Congress 2016 "Uniting the Industry", April 22-28, 2016, San Francisco, USA, http://www.wtc2016.us

International Symposium "Design of piles in Europe - How did EC7 change daily practice?", 28-29 April 2016, Leuven, Belgium, www.etc3.be/symposium2016

7th In-Situ Rock Stress Symposium 2016 - An ISRM Specialised Conference, 10-12 May 2016, Tampere, Finland, www.rs2016.org

84th ICOLD Annual Meeting, 15-20 May 2016, Johannesburg, South Africa, www.icold2016.org

GROUND ENGINEERING INFRASTRUCTURE SUMMIT 2016

18 - 19 May 2016, London, United Kingdom

Preparing the industry to procure, design and deliver future geotechnical work.

Ground Engineering is delighted to bring you a new and exciting conference for 2016, **The GE Infrastructure Summit.**

This new event for 2016 will bring together all stakeholders involved in ground engineering for UK infrastructure to draw lessons from work currently taking place in the transport, energy and utilities sectors and discuss how to improve on these schemes for future project design and delivery.

The event will provide delegates with the opportunity to gain strategic insight from major clients on the geotechnical challenges they face and technical knowledge on the individual sectors within the infrastructure industry, through breakout sessions.

The summit will bring together the whole geotechnical industry – clients, consultants, contractors, academia and suppliers – to create a forum for discussion and sharing of technical knowledge that will be vital to meeting the challenges posed by future infrastructure projects.

To receive a copy of the programme, please register your interest or email Ilya.Ryndin@emap.com

2nd International Conference on Rock Dynamics and Applications (RocDyn-2), 18 – 20 May 2016, Suzhou, China http://rocdyn.org

6th Annual UNDERGROUND INFRASTRUCTURE & DEEP FOUNDATIONS QATAR

23–24 May 2016, Doha, Qatar
oliver.osea@iqpc.ae

Delivering global insight and regional case studies for best practice in constructing underground infrastructure and deep foundations.

Building on the strong foundations of the Underground Infrastructure and Deep Foundations Qatar series, we are pleased to announce its 6th return for May 2016!

As you know there are many underground infrastructure projects in the pipeline for Qatar. From the past 5 years we have identified many challenges when developing underground infrastructure.

This year we have highlighted that the main challenges for Qatar are rising water tables, accuracy of geotechnical investigations and constructing tunnels effectively in an urban environment.

The 6th Underground Infrastructure and Deep Foundations Qatar conference aims to highlight methodologies and technologies that will combat these challenges and ensure the timely, cost-effective and efficient delivery of underground projects to create robust underground infrastructure.

So what can you expect from 2016?

- Qatar Rail: Discover how Qatar Rail aims to integrate the rail network with other pre-existing modes of transport
- AECOM: Learn about the major challenges associated with tunnel design and how they are overcome efficiently with insights from Riyadh, Qatar, Dubai, Hong Kong and Singapore
- Atkins: Address how to effectively manage the increasing threat of groundwater on underground infrastructure projects in Qatar
- COWI: Overcome the challenging performance of foundations built within a karstic environment

With huge opportunities for infrastructure projects across Qatar, this conference is the ideal place for existing players and new market entrants to access critical project intelligence.

For further information call +971 4 446 2742 or email oliver.osea@iqpc.ae.

13th International Conference Underground Construction Prague 2016 and 3rd Eastern European Tunnelling Conference (EETC 2016), 23 to 25 May 2016, Prague, Czech Republic, www.ucprague.com

GEOSAFE: 1st International Symposium on Reducing Risks in Site Investigation, Modelling and Construction for Rock Engineering - an ISRM Specialized Conference, 25 – 27 May 2016, Xi'an, China, www.geosafe2016.org/dct/page/1

14th International Conference of the Geological Society of Greece, 25-27 May, Thessaloniki, Greece, www.ege2016.gr

NGM 2016 - The Nordic Geotechnical Meeting, 25 - 28 May 2016, Reykjavik, Iceland, www.ngm2016.com

International Mini Symposium Chubu (IMS-Chubu) New concepts and new developments in soil mechanics and geotechnical engineering, 26 - 28 May 2016, Nagoya, Aichi, Japan,
www.jiban.or.jp/index.php?option=com_content&view=article&id=1737:2016052628&catid=16:2008-09-10-05-02-09&Itemid

11th HSTAM International Congress on Mechanics

May 27 - 30, 2016, Athens, Greece

Mini-Symposium

Computational Geomechanics from Micro to Macro

http://11hstam.ntua.gr

In comparison to other fields of mechanics, in geo-mechanics the medium (soil) is composed of discrete solid particles and its voids may be filled by non-solid phase materials (air and/or fluid). Despite its discrete nature, it is very common in computational geomechanics that soil is simulated via continuum analyses (with FEM or FDM) via employing constitutive models. Nowadays discrete analyses (e.g. with DEM) are gaining ground due to an increase in computational power, and even combinations thereof (e.g. FEM-DEM) have been proposed.

From a more practical point of view, the use of soil as a foundation material in civil engineering applications, makes the problem of its simulation more complicated given the interaction with the structure. Hence, on top, of the foregoing discrete (micro-scale) and continuum (meso-scale) simulations of the soil, macro-element simulations of the soil-structure-interacting foundation element have also been proposed, which are usually problem-specific (e.g. macro-element for horizontal loading of piles).

The main challenge in the micro- and meso-scale efforts is to promote accurate simulations dropping the usual simplifications (e.g. isotropy), at an acceptable computational cost and without loss of user-friendliness. In contrast, the main challenge in the user-friendly macro-scale efforts is to promote realistic simulations which are not problem-specific, and go beyond a phenomenological approach.

This Mini-Symposium aims to bridge the gap between these two paths of computational geomechanics, thus transcending from the micro-scale (of the grain) to the macro-scale (of the civil engineering structure). To do so, it invites discussion and knowledge exchange from pertinent contributions on the following topics:

- **Discrete-based modeling**, on pre- and post-failure behavior, particle shapes and size effects, dynamic behavior, bonding effects, fracturing, fluid-grain coupling,
- **Continuum modeling**, on stress-strain relations, multiphase modeling, fluid-flow modeling, dynamic behavior, liquefaction, large strain formulations
- **Macro-element modeling**, for different loading conditions (static, cyclic, dynamic), directions (translational, rotational) and for various foundation types (piles, caissons, etc).

Contact:

Hellenic Society of Theoretical and Applied Mechanics (HSTAM)
National Technical University of Athens
Zografou Campus, Athens 15780, Greece

e-mail: 11hstam@mail.ntua.gr
e-mail: vkoum@central.ntua.gr

19SEAGC – 2AGSSEAC Young Geotechnical Engineers Conference, 30th May 2016, Petaling Jaya, Selangor, Malaysia, seagc2016@gmail.com

19th Southeast Asian Geotechnical Conference & 2nd AGSSEA Conference Deep Excavation and Ground Improvement, 31 May – 3 June 2016, Subang Jaya, Malaysia, seagc2016@gmail.com

ISSMGE TC211 Conference Session within the framework of the 19th Southeast Asian Geotechnical Conference "GROUND IMPROVEMENT works: Recent advances in R&D, design and QC/QA"

ISL 2016 12th International Symposium on Landslides Experience, Theory, Practice, Napoli, June 12th-19th, 2016, www.isl2016.it

BCRRA 2017

Tenth International Conference on the Bearing Capacity of Roads, Railways and Airfields
28 –30 June 2017, Athens, Greece
www.bcrra2017.com

BCRRA 2017 Conference will cover aspects related to materials, laboratory testing, design, construction, maintenance and management systems of transport infrastructure focusing on roads, railways and airfields. Additional aspects that concern new materials and characterization, alternative rehabilitation techniques, technological advances as well as pavement and railway track substructure sustainability will be included. Providing a unique opportunity to interact and exchange and share information amongst researchers, practicing engineers and other professionals, BCRRA 2017 will welcome experts in the field from all over the world who can exchange their views and experiences, and have an outlet to discuss new concepts and innovative solutions.

Topics

The Conference will include aspects of transportation infrastructure focusing on roads, railways and airfields. Topics will concentrate but not limit to the following:

- Policies on the bearing capacity of roads, railways and airfields
- Unbound aggregate materials and soil properties
- Bound materials characteristics, mechanical properties and testing
- Traffic loading
- Field measurement techniques and analysis tools
- Pavement field evaluation
- Correlation of laboratory and field testing results
- Monitoring and assessment of roads, railways and airfields structures
- Geophysical methods for structural evaluation
- Pavement surface condition and performance assessment
- Maintenance and preservation
- Reinforcement and rehabilitation design
- Analysis of Long-Term Pavement Performance (LTPP) data
- Drainage and environmental effects
- Climate change, energy and sustainability
- Full scale testing (ALF, HVS)
- Emerging technologies
- Life cycle analysis
- Non-standard pavements
- Case histories of roads, railways and airfields

For any further information please visit the Conference website or contact us at pavnet@central.ntua.gr.

ICONHIC 2016 1st International Conference on Natural Hazards and Infrastructure: Protection, Design, Rehabilitation, 28-30 June 2016, Chania, Greece, http://iconhic2016.com

ICONHIC 2016

Performance-based soil-structure interaction of lifelines and infrastructure

A special session on "Performancebased Soil-Structure Interaction of lifelines and infrastructure is organized during the International Conference on Natural Hazards and Infrastructure to be held in Chania, Greece, 28-30 June 2016. The Special Session focuses on recent advances in Performance-based Earthquake Engineering with emphasis on dynamically interacting soil-structure systems, such as buildings, bridges, geotechnical structures, wastewater, sewage and energy pipelines, port facilities as well as on related infrastructure.

More specifically, it will encourage contributions on the analysis, design and assessment of coupled SSI systems, probabilistic evaluation and mitigation of seismic risk, fragility estimates at a component, structure and network level, structural health monitoring and innovative techniques for identifying the dynamic characteristics of flexibly supported structures, new materials and techniques for active, passive or natural (in-soil) isolation and for improving infrastructure resilience, analytical, numerical and experimental identification of dynamic SSI effects as well as optimum earthquake ground motion selection and generation for research and design purposes.

It is envisaged that the Special Session will constitute an interesting forum for researchers and practitioners at the boundaries between geotechnical and structural engineering.

Please send contributions to: gerolymos@gmail.com, asextos@civil.auth.gr & a.sextos@bristol.ac.uk

Further info iconhic2016.com

4th GeoChina International Conference Sustainable Civil Infrastructures: Innovative Technologies for Severe Weathers and Climate Changes, July 25-27, 2016, Shandong, China, http://geochina2016.geoconf.org

DFI's Deep Foundations for Landslides / Slope Stabilization and Tiebacks & Soil Nailing committees are organizing a three-day event featuring lectures by industry experts on current technologies, key design concepts and case histories that illustrate effective application of deep foundations for stabilization of slopes and excavation support. Recent and future projects will be presented that include challenging slope and landslide repairs and excavation support with deep foundation methods. Equipment, material and instrumentation suppliers, contractors, engineers, and other vendors will present their services in our Exhibit Hall. Committee meetings and exhibitor set-up are on day one with two days of technical sessions following on days two and three.

Topics

- Case Studies
- History/Theoretical Background
- Design Considerations
- Quality Control and Inspection
- Long term Maintenance
- Corrosion Protection
- Innovative Applications and Techniques
- Practice-Oriented Research

For inquiries, contact DFI at:
DEEP FOUNDATIONS INSTITUTE
Landslides Seminar Organizing Committee
326 Lafayette Avenue | Hawthorne, NJ 07506 USA
Tel: 973-423-4030 | Fax: 973-423-4031 | Email: events@dfi.org

6th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics August 1-6, 2016, Greater Noida (NCR), India, www.6icragee.com

EUROC 2016 - ISRM European Regional Symposium Rock Mechanics & Rock Engineering: From Past to the Future, 29-31 August 2016, Ürgüp-Nevşehir, Cappadocia, Turkey http://eurock2016.org

ICEGE 2016
1st International Conference on Energy Geotechnics
29-31 August 2016, Kiel, Germany
www.iceg-2016.de

The ISSMGE TC308 on Energy Geotechnics is pleased to announce the hosting of the 1st International Conference on Energy Geotechnics ICEGT 2016 in Kiel (Germany) from 29th to 31st August 2016.

With the increasing energy demand and climate change implications, the development of sustainable energy systems based on integrated schemes of energy production, transport, and transfer as well as energy storage is of utmost importance. This issue is of increasing interest to the research field of geotechnical engineering. The core of this young research area focuses on new developments and solutions for civil, environmental, and industrial applications.

With the establishment of the International Conference on Energy Geotechnics, which will be hosted at Kiel University, we want to provide a platform for interaction and communication among academic and non-academic parties from different research areas.

Session Topics

The main topics/minisymposia of the conference ICEGT 2016 are:

- Carbon Sequestration
- Energy Geo-Storage & Geo-structures
- Urban Planning for Energy Geo-Systems
- Numerical Methods and Algorithms in Energy Geotechnics
- Gas Hydrate Sediments
- Shallow & Deep Subsurface Geo-thermal Systems
- Experimental Studies & Material Design in Energy Geotechnics
- Natural & Hydraulic Fractured Reservoirs
- Nuclear Waste Deposits
- Geotechnical Challenges of Energy Infra-Structures
- Oil Sediments / Tailings
- THMC Behavior of Geomaterials
- Minisymposium "Thermo-active Foundations, Tunnels and Earth-coupled Structures", organized by Dietmar Adam, TU Wien, Austria and Malek Bouazza, Monash University, Australia

- Minisymposium "Geomechanical Characterization and Modeling of Hydrate Bearing Sediments", organized by Marcelo Sanchez, Texas A & M University, USA and Christian Deusner, GEOMAR, Germany
- Minisymposium "Trends and Challenges in Energy Geotechnical Storage Systems and Materials", organized by David M.J. Smeulders, Eindhoven University of Technology, The Netherlands and Sebastian Bauer & Frank Wuttke, Kiel University, Germany
- Minisymposium "Shallow Geothermal Systems", organized by Robert Charlier, Université de Liège, Belgium and Bertrand François, Université Libre de Bruxelles, Belgium
- Minisymposium "Geotechnics Risk and Items for Underground Nuclear Power Plants", organized by Pierre Duffaut, French Committee on Rock Mechanics
- Minisymposium "Geotechnics for Nuclear Waste Disposal", organized by Enrique Romero, Universitat Politècnica de Catalunya (UPC), Spain, Xiangling Li, European Underground Research Infrastructure for Disposal of Nuclear Waste In Clay Environment (EIG EURIDICE), Belgium and Paul Marschall, Nationale Genossenschaft für die Lagerung Radioaktiver Abfälle (NAGRA), Switzerland

ICEGT 2016 Secretariat
Phone: +49 - (0) 431 - 880 1976
Fax: +49 - (0) 431 – 880 4376
Email : secretary@icegt-2016.de

3rd ICTG – 3rd International Conference on Transportation Geotechnics 4 - 7 September 2016, Guimaraes, Portugal, www.civil.uminho.pt/3rd-ICTG2016

IAS'5 5th International Conference on Geotechnical and Geophysical Site Characterisation, 5-9 September 2016, Gold Coast, Queensland, Australia, http://www.isc5.com.au

The World Multidisciplinary Earth Sciences Symposium– WMESS 2016, 5-9 September 2016, Prague, Czech Republic www.mess-earth.org

ACUUS 2016
15th World Conference. Saint Petersburg

Underground Urbanisation as a Prerequisite for Sustainable Development
September 12-15, 2016
http://acuus2016.com

The 15th World Conference of the Associated research Centers for the Urban Underground Space will be held in Saint Petersburg, **September 12-15, 2016**. The main theme of ACUUS 2016 is Underground Urbanisation as a Prerequisite for Sustainable Development.

ACUUS Conference is the worldwide event in the field of underground construction. This Conference has been held for the last 30 years in different cities at the highest level. ACUUS 2016 will serve as a platform for recognized experts in the field of underground urbanism, investors, representatives of the authorities and public organisations.

The ACUUS conference series has been held previously in Sydney (Australia, 1983), Minneapolis (USA, 1986), Shanghai (China, 1988), Tokyo (Japan, 1991), Delft (The Netherlands, 1992) , Paris (France, 1995), Montreal (Canada, 1997), Xi'an (China, 1999), Turin (Italy, 2002), Moscow (Russia, 2005), Athens (Greece, 2007), Shenzhen (China, 2009), Singapore (2012), Seoul (2014).

The main topics of the Conference are:

1. Urban planning of underground space for comfort living, historic centers preserving, improving environmental situation.
2. Progress of geotechnical surveys for planning underground space development, importance of geotechnics and hydrotechnics for the choice of engineering and design solutions.
3. Symbiotic relation between ground urban development, underground infrastructure and nature for creation of a single landscape, aesthetic and comfort of underground structures.
4. Underground metro systems, transport tunnels, integrated interchange hub as a prerequisite for regional development and securing comfort and safe conditions.
5. Underground structures in permafrost, shelf zone development. Energy efficiency of underground structures.
6. Advantages of underground construction for safety and preventive measures from natural disasters. Environmental management and improvement of the environmental quality.
7. Trenchless technology, the role of the underground utility lines in integrated urban underground space development.
8. Strengthening the investment appeal of underground structures by improving legislation and public-private partnership principles and harmonizing technical regulations.
9. State-of-art technologies, equipment and construction materials that are currently in use for underground infrastructure development.

To receive information for the Conference please contact the Secretariat via e-mail at info@acuus2016.com.

SAHC 2016 - 10th international Conference on Structural Analysis of Historical Constructions 13-15 September 2016, Leuven, Belgium, www.sahc2016.be

13 Baltic States Geotechnical Conference Historical Experiences and Challenges of Geotechnical Problems in Baltic Sea Region, 15 - 17 September 2016, Vilnius, Lithuania, http://www.13bsgc.lt

ACE 2016

12th International Congress on Advances in Civil Engineering

21-23 September 2016, Istanbul, Turkey
http://www.ace2016.org

12th International Congress on Advances in Civil Engineering (ACE2016) will be held in Istanbul, Turkey, September 21-23, 2016. This event will provide an excellent oppurtunity for the participants from around the world to meet, exchange new ideas and share knowledge, interests and experiences while enjoying the magnificent city of Istanbul.

The traditional ACE Congresses have been hosted every two years by one of the organizing universities: Boğaziçi University, Eastern Mediterranean University, Istanbul Technical University, Karadeniz Technical University, Middle East Technical University and Yıldız Technical University, with the support of Turkish Chamber of Civil Engineers.

ACE 2016 will be a venue for researchers and experts to present and discuss the recent progesses in all fields of civil engineering. In addition, well known experts will be delivering keynote lectures, presenting the state-of-art in their field of research. The conference will provide a great opportunity to get together the civil engineering community to share recent advances and cutting edge developments.

TOPICS

- Coastal Engineering
- Environmental Engineering
- Construction and Project Management
- Mechanics
- Geotechnical Engineering
- Hydraulics and Groundwater Engineering
- Construction Materials
- Structural Engineering
- Transportation Engineering

Organizing Secretariat

DEKON
CONGRESS & TOURISM

Yıldız Posta Cad. Akın Sitesi 1. Blok No: 6 K: 1 D: 3 Beşiktaş / İstanbul
Tel: +90 212 347 63 00 - Fax: +90 212 347 63 63
E-mail: secretariat@ace2016.org
Web: www.dekongroup.com

🙞 🙜

EuroGeo 6 – European Regional Conference on Geosynthetics, 25 – 29 Sep 2016, Istanbul, Turkey, www.eurogeo6.org

🙞 🙜

8th Nordic Grouting Symposium
State of the art – Future Development

26-27 September 2016, Oslo, Norway
http://nordicgrouting.com

The Norwegian Group of Rock Mechanics (NBG) and the Norwegian Tunnelling Society (NFF) have the pleasure to announce that the 8th Nordic Grouting Symposium will take place 26-27th of September 2016. The symposium will be held at Radisson Blu Scandinavia Hotel in Oslo, Norway. We hereby invite our Nordic colleagues to present papers, exchange experiences and discuss the latest development in Rock Grouting amongst like-minded.

Rock Grouting has a long history starting with dam construction and rehabilitation to challenging ground improvement for mining, tunnelling, rock mechanics and environmental remediation. Rock grouting is typically performed to reduce the hydraulic conductivity of, or more appropriately, across a rock mass by injection of grout into the rock´s joints and fissures.

The Eight Nordic Symposium on Rock Grouting will have special focus on mechanisms, theories, and practical applications of grouting for permeability reduction into underground structures and groundwater cutoffs. We are particularly anxious to elaborate on the latest news on grout technology and future development. As the symposium is Nordic, it will also reflect basic cultural differences between pure theoretic science and pragmatic empirical differences.

Subjects for the Symposium

- Case studies, recent Nordic projects, and international hard rock projects / examples
- Grouting approach and strategy
- Properties – materials, rock mass, accessories and equipment
- Groutability / Grout penetration
- Grout pressure
- Development potential – equipment, software, documentation and analysis

🙞 🙜

5th International Scientific Conference on Industrial and Hazardous Waste Management, 27 - 30 September 2016, Chania, Crete, Greece, http://hwm-conferences.tuc.gr

🙞 🙜

2nd International Specialized Conference on Soft Rocks – ISRM 2016
Understanding and interpreting the engineering behavior of Soft Rocks

6-7 October 2016, Cartagena, Colombia
www.scg.org.co/?p=1634

Contact Person: Mario Camilo Torres Suarez
Address: Calle 12C, No. 8-79 Of. 512
Telephone: +57 1 3340270
Fax: +57 1 3340270
E-mail: sociedadcolombianadegeotecnia@scg.org.co

ARMS 9, 9th Asian Rock Mechanics Symposium, ISRM Regional Symposium, 18-20 October 2016, Bali, Indonesia, http://arms9.com

SFGE 2016 Shaping the Future of Geotechnical Education International Conference on Geo-Engineering Education 20 - 22 October 2016, Minascentro, Belo Horizonte, MG, Brazil, http://cobramseg2016.com.br/index.php/sfge-sobre/?lang=en

10th ICOLD EUROPEAN CLUB SYMPOSIUM & **EXHIBITION**

25-30 OCTOBER 2016 ANTALYA / TURKEY

http://trcold.com/

The International Commission on Large Dams (ICOLD) Annual Meeting was held in Antalya in 1999. In 2009, Istanbul hosted the 5th World Water Forum. In October of 2016 the 10th ICOLD European Club Symposium will return to Turkey and will be hosted in Antalya, once again between the 25th to the 30th of October 2016.

Under the sponsorship of 'The Ministry of Forestry and Water Affairs', and in cooperation with the 'The State and Water Affairs General Directorate (DSI)', and 'The Turkish National Committee of the International Commission on Large Dams (TRCOLD)' we hope to organize 'The 10th ICOLD Europe club symposium'. With this cooperation, we aim to shed the light on the issues related to the main theme of ICOLD "Sustainable Development for Dams" andachieve the results we need.

The Symposium will cover subjects such as, design and construction of hydroelectric dams, Safety of Dams, Rehabilitation and Monitoring, Risk Management in building dams, and hydroelectric dams and the socio-economic and environmental aspects. In addition workshops regarding topics such as, geomembrane applications, measuring instruments in dams, waste dams, electromechanical and hydro mechanical equipment will be organized. This is in order to provide the latest technological updates to the participants.

During the symposium, technical presentations and seminars will take place and a technical exhibition will be organized. Moreover, a special program will be arranged to include technical trips to projects near Antalya, in addition to trips to nearby cultural, historical and touristic sites.

The following 4 main subjects will be discussed during the Symposium:

- Dam Rehabilitation
- Financing of Dam Projects
- Environmental/Social Impacts & Climate Change
- Dam Safety

The theme of the Symposium is foreseen as **"Dams for Sustainable Development"**.

Contact:
Devlet Mahallesi , Inonu Bulvari No: 16 Cankaya / ANKARA -TURKEY
PHONE: +90 312 454 54 54
e-mail: info@trcold.com
Fax: + 90 (312) 454 55 05

GeoAsia 6 - 6th Asian Regional Conference on Geosynthetics 8-11 November 2016, New Delhi, India, http://seags.ait.asia/news-announcements/11704

RARE 2016 Recent Advances in Rock Engineering 16-18 November 2016, Bangalore, India, www.rare2016.in

TBM DiGs Istanbul 2016

2nd International conference on "TBM DiGs in difficult grounds"
16-18 November 2016, Istanbul, Turkey
hwww.tbmdigsturkey.org

The first International conference on "TBM DiGs in difficult grounds" was held in Singapore with a great success in 18-20 November. The permanent committee decided the second conference in this series to be held in Istanbul in 16-18 November 2016 by Turkish Tunnelling Industry and the third in China.

Turkey has a great potential of Tunnelling and in the near future it is planned to spend 35 Billion USA dollars in Tunnelling in Turkey. It is expected that TBM Tunnelling will have a big share within these activities. The geology of Turkey is very complex including North and East Anatolian faults, tectonic activities and shear zones, rock and soil mixed and interfaced grounds, spalling and bursting rocks, squeezing and swelling grounds, blocky and highly fractured rocks and grounds under high in situ stress and water pressure and gassy rock formations. Improvement and optimisation of TBM's performance in those difficult ground conditions require good scientific understanding, innovative technology development and good engineering practice, that involve tunnelling and geotechnical engineers, designers and contractors, TBM manufacturers and material suppliers, and researchers.

TBM DiGs (Tunnel Boring Machines in Difficult Grounds) is planned to be an international conference series to provide a specialised technological forum discussing and exchanging knowledge related to TBM works in difficult grounds. The conference plans to cover a wide range including characterisation of difficult grounds, field observations and case studies, physical and laboratory tests, numerical modelling and techniques, treatments of difficult grounds, TBM design and installation, tunnel support design, monitoring and risk management.

General Topics of Symposium

- Tunnel Project Designing
- Site Investigations
- Management
- Health and Safety
- Performance Prediction and Analysis
- Ground treatment
- Risk Analysis
- Segmental Lining and Support Design
- Chemical Additives
- Case studies
- Instrumentation and Monitoring
- Backup Systems
- New Technologies
- Other (topics will be considered)

For all queries regarding TBM DiGs, please contact:
TBM DiGs Conference Secretariat
Email: contact@tbmdigsturkey.org
Post Address:
TBM DiGs Turkey Conference
c/o
Istanbul Technical University (ITU)
Faculty of Mines
Mining Engineering Department
Ayazaga Campuse
34469 Maslak, Istanbul, TURKEY

International Symposium on Submerged Floating Tunnels and Underwater Tunnel Structures (SUFTUS-2016)

16—18 December 2016, Chongqing, China
www.cmct.cn/suftus

The Organizing Committee of SUFTUS -2016 is pleased to announce that the International Symposium on Submerged Floating Tunnels and Underwater Tunnnel Structures (SUFTUS-2016) will be held in Chongqing, China during 16-18 December 2016.

Submerged floating tunnel (SFT), also called Archimedes Bridge (AB), belonging to the category of underwater structure, is a kind of floating transportation passage which is submerged underwater to bridge water banks. As an innovative transportation technology, SFT will become attractive in competing with traditional techniques due to its economic and environmental advantages. However at the present time, there is still not an actual SFT being built in the World.

The First International Symposium on Archimedes Bridge (ISAB-2010) was held in Qiandao Lake, China during 17-20 October, 2010. In the past 6 years, new theory and new technology about SFT and underwater structure were developed. The aim of SUFTUS-2016 is to provide a global forum for scientists, engineers and technicians around the world, who are involved or interested in researches and developments on the innovative technologies of SFT and underwater structure, to share their research progresses and conceptual design advances, so that to discuss and improve the challenging issues of SFT and underwater structures.

Main Topics

- Conceptual design
- Prototype strategy and design
- Underwater tunnel
- Applicability and key technical indexes
- Dynamic response to hydrodynamic loads
- Dynamic response to seismic, tsunami and other accidental loads
- Connections and foundations
- Materials selection and resistance
- Structural analysis and safety assessment
- Environmental and economic assessment
- Construction and installation
- Lighting and ventilation
- Escape and rescue
- Other related topics

AfriRock 2017, 1st African Regional Rock Mechanics Symposium, 12 – 17 February 2017, Cape Town, South Africa, www.saimm.co.za/saimm-events/upcoming-events

World Tunnel Congress 2017
Surface problems – Underground solutions

9 to 16 June 2017, Bergen, Norway
www.wtc2017.no

"Surface problems – Underground solutions" is more than a slogan; for ITA-AITES and its members it is a challenge and commitment to contribute to sustainable development. The challenges are numerous and the availability of space for necessary infrastructure ends up being the key to good solutions. The underground is at present only marginally utilized. The potential for extended and improved utilization is enormous.

EUROCK 2017
13-15 June 2017, Ostrava, Czech Republic

Contact Person: Prof. Petr Konicek

Address
Studentska 1768
708 00 Ostrava-Poruba
Czech Republic
Telephone: + 420 596 979 224
Fax: + 420 596 919 452
E-mail: petr.konicek@ugn.cas.cz

ꕥ ꕥ

GeoMEast2017

15 - 19 July 2017, Sharm El-Sheik, Egypt
www.geomeast2017.org

On behalf of the Organizing Committee, we are pleased to invite you to attend the GeoMEast 2017 International Conference to be held in Sharm Elsheikh, Egypt from July 15 to 19, 2017. The GeoMEast SERIES is managed by SSIGE and supported by a number of leading international professional organizations.

Recent rapid construction in Egypt and the Middle East has provided great opportunities for bridge, pavement, geotechnical, geological, tunnel and all engineers to use their knowledge and talents to solve many challenging problems involving highways, bridge structures, pavements, materials, ground improvements, slopes, excavations, dams, canals and tunnels with innovative solutions and cutting-edge technologies.

GeoMEast 2017 will provide a showcase for recent developments and advancements in design, construction, and safety Inspections of transportation Infrastructures and offer a forum to discuss and debate future directions for the 21st century. Conference topics cover a broad array of contemporary issues for professionals involved in bridge, pavement, Geomechanics, geo-environmental, geotechnical, geosciences, geophysics, tunnel, water structures, railway and emerging techniques for safety inspections. You will have the opportunity to meet colleagues from all over the world for technical, scientific, and commercial discussions.

Technical Themes

Geotechnical, Geological, Geoenvironmental and Geosynthetics

- Geotechnical, Geoenvironmental and Earthquake Geotechnical Engineering;
- Soil and Rock Mechanics, Geomechanics, Mining, and Geological engineering;
- Geosynthetics and Reinforced Soil Retaining Structures;
- Behavior, Identification and In-situ Test Methods for Site Characterization of Soils, and Lateritic, Problematic, Collapsible, Swelling, Soft, Sabkha and Uncommon Soils;
- Design and Quality Control of Earth Structures and Subgrades;
- Soil Stability and Landslide, Ground improvement and Seismic Hazards;
- Soil-Structure Interaction, Advanced Analysis of Shallow and Deep Foundations, Foundation Failure and Repair, andMicroPiles and its innovative applications;
- Computational Mechanics, Innovative Soil Models, Discrete Element and Boundary Element Modelling, Meso-scale Modeling, and Advanced Numerical and Analytical Analyses;
- Physical Modelling in Geotechnics;
- Saturated and Unsaturated Soil Mechanics;
- Oil and Gas, and Petroleum Geotechnical Engineering;
- Geosciences, Geomatics, Geoinformatics, Geophysics and Global Hazards.

Sustainable Infrastructures

- **Structures and Bridges Engineering:** Advanced Analysis of Structures; Non-Destructive Evaluation; Inspection Technologies; Structural Health Monitoring; Remote Monitoring of Structures; Scour Assessment; Seismic Design Issues for Bridges, Super Structures and Underground Structures; Design Methods and Materials, Innovative Repair Methods and Materials, Durable and Sustainable Designs, Innovative Materials, Advances in Foundation Design/Construction, Accelerated and/or Performance Based Design/Construction, Aesthetics and Environment; State-of-the-Arts and State-of-the-Practices on Bridge Design, Construction and Maintenance; Special Foundation Treatment and Settlement Control Technology.
- **Tunneling Engineering:** Tunnel Management and Inventory, Monitoring and Settlement Control; Emerging Technologies, Lining Design & Precast Segment Advances; Innovation in Tunneling Design, Construction, Repair, Rehabilitation; Fire & Life Safety, Vulnerability & Security; Tunneling in Soft Ground, Ground Conditioning and Modification; Advanced prediction technology of tunnel construction geology; Deep excavations and urban tunneling.
- **Pavement Engineering, Airports and Advances in Pavement Techniques:** Airfield pavement analysis, rehabilitation and performance; Recycled Asphalt Pavement; Pavement Design, Modeling, Performance Evaluation, & Management; Sustainable Long Life Pavement; Ground Improvement, and Chemical/Mechanical Stabilization for Pavement and Geotechnical Applications; Moisture Damage in Asphaltic Concrete Materials; Pavement Foundations: Modelling, Design and Performance Evaluation; Geotechnical Properties and Their Effects on Portland Concrete Pavement Behavior and Performance; Warm Mix; Rehabilitation strategy selection and preventative maintenance treatments; Accelerated Testing of Pavement Structures and Materials; Material, Design, Construction, Maintenance and Testing of Pavement; Asphalt Binder and Mixture Characterization; Construction and Rehabilitation of Jointed Concrete Pavement, Reinforced Concrete Pavement, and Continuously Reinforced Concrete Pavement; Bridges Deck Pavement; Stabilization, Recycling, Foamed Bitumen and Emulsion, Granular Materials; Roadway Widening; Asphalt Mix-Design, HMA; Testing & Material; Property Characterization.
- **Transportation Engineering:** Highway Pavements: Design, Materials, and Construction; Transportation Operations and Safety; Advanced Technologies, Infrastructure Systems, Intermodal Transportation, Planning, and Development; Rail and Transit; Aviation
- **Railroad and Railway Engineering;** Railway and Railroad Track Substructure; High Speed Rail System; Seismic Design for Railway and Roadway Structures; Economics of Railway Engineering and Operations; Structures, Maintenance and Construction; Innovative Procedures and Precautions; Long Term Pavement Performance Contest; BIM and Contract Administration.
- **Dams Engineering, Canals and Levees, Irrigation and Water Sources and Structures, and Ports, Offshore and Marine Technologies.**

- **Smarthome, barrier-free building and reconstructing.**

Climate Change and effects on Infrastructure

- **Sustainability and Energy Engineering;**
- **Environmental and Waste / Sediment Management, Characterization, Treatment and Re-Use;**
- **Energy Geotechnics and Geo-Energy Infrastructure.**
- **Materials Engineering, Nanotechnologies, Advances in Composite Materials, Climate-Friendly Technologies, and Damage Mechanics.**
- **Structural Health Monitoring, and Sustainable Construction Technologies;**
- **Advanced Analysis for Sustainable Design.**
- **Worldwide innovative procedures and precautions for the Design;**
- **Building Information Modeling (BIM), Building and Construction Engineering, Project Management, and Contract Administration; and**
- **Sustainable Infrastructure:** Current and Projected; Financing Infrastructure Projects; Cross-cutting Issues; Materials, Tools, and Methodologies; Innovation; Sustainability and Competitiveness; Risk, Resiliency, and Adaptation to Climate Change; Sustainable Cities; Sustainability, Society and Culture; Envision™ and Other Rating Systems; Special Topics on Middle East Urbanization.

Send your queries to: Info@GeoMEast2017.org, Info@SSIGE.org, or Call: +201110666775, +201005575815

19th International Conference on Soil Mechanics and Geotechnical Engineering, 17 - 22 September 2017, Seoul, Korea, www.icsmge2017.org

AfriRock 2017
1st African Regional Rock Mechanics Symposium
2-7 October 2017, Cape Town, South Africa

Contact Person
Raymond van der Berg, Head of Conferencing
Address: SAIMM, P O Box 61127, Marshalltown 2107
Telephone: +27 (0) 11 834-1273/7
E-mail: raymond@saimm.co.za

GeoAfrica 2017
3rd African Regional Conference on Geosynthetics
9 – 13 October 2017, Morocco

11th International Conference on Geosynthetics (11ICG)
16 - 20 Sep 2018, Seoul South Korea
csyoo@skku.edu

10th Asian Rock mechanics Symposium - ARMS10
October 2018, Singapore

Prof. Yingxin Zhou
Address:
1 Liang Seah Street
#02-11 Liang Seah Place
SINGAPORE 189022
Telephone: (+65) 637 65363
Fax: (+65) 627 35754
E-mail: zyingxin@dsta.gov.sg

AFTES International Congress
"The value is Underground"
13-16 November 2017, Paris, France

World Tunnel Congress 2018
20-26 April 2018, Dubai, United Arab Emirates

EUROCK 2018
22-26 May 2018, Saint Petersburg, Russia

Contact Person: Prof. Vladimir Trushko
Address: 21-st line V.O., 2
199106 St. Petersburg
Russia
Telephone: +7 (812) 328 86 71
Fax: +7 (812) 328 86 76
E-mail: trushko@spmi.ru

cs 80

UNSAT2018 The 7th International Conference on Unsaturated Soils, 3 - 5 August 2018, Hong Kong, China, www.unsat2018.org

cs 80

ARMS10
10th Asian Rock Mechanics Symposium
ISRM Regional Symposium
October 2018, Singapore

Contact Person: Prof. Yingxin Zhou
Address: 1 Liang Seah Street
#02-11 Liang Seah Place
SINGAPORE 189022
Telephone: (+65) 637 65363
Fax: (+65) 627 35754
E-mail: zyingxin@dsta.gov.sg

cs 80

14th ISRM International Congress
2019, Foz de Iguaçu, Brazil

Contact Person: Prof. Sergio A. B. da Fontoura
E-mail: fontoura@puc-rio.b

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Tunnelling: Going underground

The 15.4km Ceneri tunnel is part of the Alp Transit scheme

Completion of running tunnels for London's huge Crossrail scheme was a major highlight this year, as the last of eight Herrenknecht TBMs (tunnel boring machines) broke through in May, meaning that 21km of new twin bore tunnel has now been threaded through complex cluttered ground beneath Britain's capital.

The last TBM, Victoria, completed one of two parallel 8.3km bores from the east to Farringdon Station in central London – the longest drives. Six 7.1m diameter EPBs (earth pressure balance) worked on the project which also used two slurry type Mixshields for a crossing under the River Thames. Work to dismantle Victoria began in the summer.

The tunnels are the central element of the overall £14.8 billion (€20.5 billion) project which forms a new 118km long link from the east to the west of London. There are expected to be 200 million passengers annually.

Work continues on station caverns, primarily with spray concrete methods, and fitting out for both stations and rail. Trains are due to run at the end of 2018.

London's tunnellers have another project to occupy them – the huge £4.2 billion (€5.8 billion) Thames Tideway interceptor, a 25km long sewage overflow storage and transport tunnel, 7.2m diameter running up to 65m deep, mostly underneath the river. It will eliminate storm overflow into the river from 34 existing sewers.

The seven-year construction starts next year, overseen by specially-created independent company Balzagette Tunnel for utility company Thames Water. Contractors selected include major European firms BAM Nuttall, Ferrovial Agroman, Balfour Beatty, Costain and Vinci Construction.

Second largest

The second largest project in Europe is the Stuttgart 21 underground station and rail scheme in Germany, and the associated Stuttgart-Ulm high-speed rail project, both of which involve multiple tunnels. Taken together, they are costing around €10 billion. Both are now significantly into construction after years of controversy and protest.

The city project is building a new central station, underground in the heart of the city, with eight tracks running at 90º to the orientation of the 15-platform existing station. The client, Deutsche Bahn, said that despite fewer lines, the through nature of the station was quicker and faster than the existing in-out terminus, which funnels into just five exit lines.

The project involves reconfiguring local and regional lines with a series of radiating soft ground tunnels in the city, which is enclosed by hills on three sides. Complex work is needed beneath buildings and a river crossing.

There is also a new high-speed rail link running out southeast through the largest of the tunnels, the 9.5km hard rock Filder tunnel which is currently being driven.

Austrian contractor Porr is working from the southern portal, using TBM drives and a central 1.5km long section of drill and blast. The drill and blast is needed to pass through anhydrite Keuper gypsum which must be kept dry to avoid expansive reaction with water which could trap a machine. Special water seals have to be installed around the tunnel bores.

Work on the first bore began in autumn last year using a 10.82m Herrenknecht multimodal machine, in EPB mode. Spoil goes to the surface with a Swiss Agir conveyor for immediate loading for truck disposal from a tightly constrained worksite. To save space, segments arrive on a just-in-time basis by train from precast works operated by contractor Max Bögl near Berlin.

The first 4.5km is just finished, and the TBM is being dismantled and moved to the portal for a parallel drive beginning next spring. Atlas Copco rigs are starting the centre sections. After its second drive the TBM will be hauled through the conventional sections for two more drives at the far end.

At this city end, meanwhile, large NATM (new Austrian tunnelling method) caverns are being made for the TBM reception and turn, and for link tunnels into the station. Sophisticated compensation grouting is needed to stop the settlement of buildings above the tunnel. Specialist consultant Professor Walter Wittke is advising on the tunnel and this work.

Five tunnels

He is also working on the high speed link to Ulm, which continues from where the Filder finishes at the airport with another 60km of new line. Some five major tunnels are required, several in construction for the last three years.

The biggest are under the Schwabian Alps, a highland national park where two tunnels, totalling 14km take the line upwards and another, the 5.5km long Albabstieg, descends into Ulm.

Difficult karstic limestone and squeezing conditions are being tackled for the first ascending tunnel – the Bossler. Part of this is driven by an 11.3m Herrenknecht TBM, while the remainder is using drill and blast methods. The same Porr-led joint venture is doing this work.

It has also just completed the 4.8km long Steinbühl tunnel, which continues the upward climb after a 485m bridge over a narrow valley. Despite further difficult karstic limestone sections, this twin bore has gone well and breakthrough was due to be celebrated on 6 November, six month ahead of schedule.

A further soft ground tunnel of 7km is still in preparation along the line.

Even bigger high speed tunnels are underway through the Alps linking northern Europe to Italy.

The largest is the world record 57km long Gotthard Base tunnel, up to 2,500m deep, where track laying is complete and the opening is expected to be in June next year.

The AlpTransit scheme includes a second tunnel further south, the 15.4km long twin-bore Ceneri where drill and blast operations with Sandvik rigs and a Rowa backup system are nearly complete. This was one of the first major projects for Agir conveyors.

Two southern drives were completed in March and more difficult 8km northern drives will finish by the end of the year when rail and signalling work begins. The Ceneri will shave a further 10 minutes from the Zurich to Milan route when complete.

Austria to Italy

Meanwhile, attention has moved to Austria and Italy where not only the great Brenner Pass base tunnel is well underway, but two more base tunnels as well – Koralm and Semmering.

The Brenner, from Tyrolean capital Innsbruck to Fortezza in Italy, forms part of the Trans-European Network (TEN-T) route from Berlin to Palermo. It is comparable to Gotthard at 55km long and has a maximum cover of 1,800m. If taken together with a 9km linked bypass tunnel at Innsbruck for trains heading onwards, it will claim a world record length of 64km.

Between two single-track main bores of 8.1m in diameter there is a smaller central service tunnel of just under 5m inner diameter and running 12m lower. It serves for later maintenance and drainage but is also vital for exploration and geological investigation, according to the client, the Austro-Italian Brenner Base Tunnel company.

Preparation for the main tunnel drives has been underway for several years, with five major access adits virtually complete, including a 6km length of the exploratory from Innsbruck. The most important work recently has been a 1.5km long, conventionally excavated section across the Periadriatic fault on the Italian side. This tectonically crumbled rock was potentially a major obstacle, but while the fractured rock was difficult going, it has proved passable. The same contract, completed this year also excavated and lined the first two 1.5km sections of the main bores.

The next major work is an additional 15km of exploratory tunnel being made with a Herrenknecht gripper TBM southwards from the initial Innsbruck section. It started this October after assembly in an underground cavern.

The €380 million multipart contract was let to Austrian contractor Strabag with Salini Impregilo from Italy in September last year. Work also includes completing more access points in the Innsbruck area, and a long 9km drill and blast drive parallel to the bypass tunnel as a safety tunnel.

Austria has another trans-European high speed link underway, upgrading the line from Vienna to Graz, and with an entire new line section onwards to Klagenfurt.

A key feature of the link is the 32.8km Koralm tunnel with maximum cover of 1,200m, and like other base tunnels it has a very flat gradient. Apart from a small 1.5km portal section begun in 2011, it is being driven in two main contracts.

The largest is by contractor Strabag and joint venture partner Jägerbau with 20km to do. A first section of around 3km was in soft ground while the rest is parallel hard rock drives – one of 16km and one 17m, both with segmental linings.

Begun two years ago, these have proved slow going in hard and often blocky rock, though the contractor is pleased with its two "tough" CREG-Wirth TBMs now over 11km in. The client, Austria's Federal Railways civil engineering company ÖBB Infrastruktur, has said that things are within the parameters of the contract for the eventual 2018 completion.

The remaining approximately 12km of tunnel was let last year to Porr, and is being driven by conventional methods in one tube, where half was excavated in the investigation stage, and by a multimode Herrenknecht TBM on the full length of the other bore.

North of Graz, meanwhile, the 27km long Semmering is just starting. Cutting under the historic but speed- and gradient-limited Semmering mountain railway, it will also provide a flat gradient for high speed trains.

Because of exceptionally complex geology and high water heads, investigated in detail over the last decade, the tunnel is divided into several sections, mostly to be built by conventional means. Contracts are currently being let.

Only one central section of 9km can be done by TBM, starting from a cavern at the base of a 400m deep shaft currently under construction by a joint venture of Implenia and Svedelski. Some 4.4km of conventional drive will head in the other direction from the shaft cavern.

A 7.4km section from Gloggnitz at the east portal has been let to Hochtief Infrastructure Austria, Implenia Austria and Thyssen Schachtbau for €457 million. Work will go from the portal and an access shaft.

Cross border

One final trans-European base tunnel route is the 57km Lyon to Turin cross-border project. Final go ahead was agreed in February between France and Italy. An EU subsidy of 40% of the €8.8 billion cost, was agreed in July.

The tunnel between St Jean-de-Maurienne in French Savoy and the Susa valley in the Piedmont will have twin bores with a separation of 30m. The inner diameter will be 8.4m – slightly larger than Gotthard and Brenner – allowing clearance for lorry shuttle trains.

There had been work on access and exploratory tunnels completed in recent years but full commitment to the scheme has been uncertain until now.

A fourth access and exploratory adit on the Italian side is still in excavation and about half complete. It began later in 2013 because work had previously been disrupted by hostile demonstrations. This Maddalena tunnel site still has a police guard.

It is using a 6.3m diameter Robbins main beam TBM both to test possible TBM drive conditions and gather rock data.

On the French side, another test tunnel contract has just been let to Spie Batignolles, for a 9km section of one of the two main bores. It will use an NFM TBM with overcutting facility to explore rock conditions and possible squeezing ground.

Moving further north, Norway is currently excavating the deepest ever undersea road tunnel – the 14.3km Solbakk tunnel at Stavanger – reaching 290m depth. It is part of a three tunnel scheme for the coastal city, the Ryfast, and is being driven by drill and blast through hard gneiss and softer phyllite claystone.

Atlas Copco rigs with Volvo loaders and trucks are in use for one of the two contracts while Swiss firm Marti on the eastern 7.8km section is using Sandvik rigs and, for the first time in Norway, a conveyor muck system, supplied by sister firm, Marti Technik.

An even bigger and deeper road tunnel from Stavanger northwards, the Rogfast, is currently in design.

Meanwhile, at Bergen, a Herrenknecht hard rock gripper TBM is just being readied for a 7km drive through very hard granite for the Ulriken tunnel at the end of the Bergen to Oslo rail line. It is the first TBM drive for a rail tunnel in Norway.

Joint venture contractor Skanska-Strabag will also use conveyors for spoil, this one from Agir.

The tunnel will double track an existing single bore open since 1964. Work began last year with an initial 800m drill and blast section for track crossover and line branching into platforms on a station at Arna. An Atlas Copco rig drilled and Volvo wheeled loaders and trucks moved out the spoil.

High-speed rail

Norways' biggest project is the Follo high-speed rail line from Oslo to commuter town Ski, mostly in a 20km twin-bore tunnel.

Contractors Acciona and Ghella have ordered four Herrenknecht TBMs to begin excavation work late next year. Another contract with Italian contractor Condotte d´Acqua will use "drill and split", the first use of the method in Norway which replaces blasting with hydraulic wedges to remove rock.

Sweden began work early this year on the huge ten-year Stockholm bypass scheme which will put a dual three-lane motorway underground on the west side of the city through typical Scandinavian hard rock.

Czech firm Subterra is making the access tunnels, and contracts for major work beginning next year are with Implenia, Skanska and Norway's Veidekke.

Finally, literally on the edge of Europe, this autumn saw breakthrough of the spectacular 5.4km long Eurasia tunnel, a twin-deck dual two-lane road tunnel underneath the Bosporus in Istanbul, Turkey, which has taken high pressure working to a new level.

A giant Herrenknecht Mixshield drove the central 3.34km section in both saturated soft ground and rock at maximum depth of 106m with pressures at an unprecedented 12bar.

(Adrian Greeman / CONSTRUCTION europe, 02 Dec 2015, http://www.khl.com/magazines/construction-europe/detail/item113674/Tunnelling:Going-underground)

A cut slope failure on the Eskoriatza to Vitoria motorway in Spain

An interesting landslide occurred on a heavily modified slope on the Eskoriatza – Vitoria motorway in Spain on 27th November 2015. The main failure event was captured on video, and is now on Youtube:

https://www.youtube.com/watch?time_continue=2&v=TRhktvXBbC8.

I am impressed with the boldness of the highway authority in allowing one side of the road to remain open whilst this failure occurred.

Very helpfully, Fats Grasas has tweeted a sequence of images from a range of sources of the history of the slope. This appears to be a Google Street View image from 2009:-

Eskoriatza – Vitoria motorway slope via Fats Grasas

Whilst this is a Google Earth image, also from 2009. The slope clearly has expensive treatment, but I am unsure as to what this is exactly.

Eskoriatza – Vitoria motorway slope via Google Earth and Fats Grasas

Then this Google Street View image is from earlier this year:

Eskoriatza – Vitoria motorway slope via Google Street View and Fats Grasas

The slope has clearly undergone a major failure, part of which has spilled onto the road. A Google Earth image, also from earlier this year, shows this failure in more detail:

Eskoriatza – Vitoria motorway slope via Google Earth and Fats Grasas

It appears that this failed slope was being repaired, with substantial reinforcement and fill. These slope strengthening works appear to have failed to generate the landslide last week.

(dr-dave / AGUBlogosphere / THE LANDSLIDE BLOG, 3 December 2015, http://blogs.agu.org/landslideblog/2015/12/03/eskoriatza-1/)

cs ഇ

Releveling buildings and structures

Mainmark Ground Engineering has developed an exciting new digitally controlled process for lifting and releveling buildings and structures. Take a look at our website. The process, called JOG, has been proven in Japan and New Zealand over a period of 20 years. It has been used successfully to lift a 4 storey building the size of a football pitch by 180mm while the building was occupied; a 12 storey office building by 100mm; a 1500mm dia. pipeline by 65mm; a highway bridge-culvert by 1200mm; and many other structures; the complex or the huge, the heavy and the delicate.

The words 'keyhole surgery' are used to describe JOG due to the minimal intrusion of the works into the lives and business processes of our clients. Digitally controlled multi-point cement injection under the foundations lifts the structure uniformly point by point while the lifting of each part of the building or structure is being real-time digitally controlled and millimeter-monitored by robot instrumenttation. Watch the video of the 3D modelling and processes.

The 17th November Issue of NCE featured the lifting and releveling by Mainmark of the Christchurch Art Gallery. Please watch for yourself the video of the gallery being lifted.

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

What Can Australia Learn from the Christchurch Rebuild?

When disasters strike, engineering and leadership challenges involved in conducting emergency repairs and undertaking subsequent rebuilding can be significant.

When a massive earthquake hit Christchurch in February 2011, however, these were taken to another level.

The quake, which measured 6.3 on the Richter scale, killed 185 people, damaged more than 100,000 homes and caused around 70 per cent of the structures within the CBD east of the Avon River to have to be knocked down. It was one of around 16,000 such quakes to hit the region over a 16-month period.

As expected, not all was plain sailing. In July 2013, Christchurch City Council was stripped of its power to issue building consents over concerns about the quality control associated with its consenting processes, only re-gaining accreditation last year. What was seen as an excessively slow rebuilding process was slammed by owners of property in the city's centre, who complained of the city being locked up for too long. While the majority of residents had a positive experience with regard to their insurance, a significant number did not, and there were cases in which insurers dithered and remedial work performed under insurance arrangements was sloppy.

Yet almost five years on, a large scale exodus of population and/or capital has not happened, the city now has almost as many shops, cafés and pubs as was the case before the earthquake hit, and the rebuild has for the most part been a success.

Now is a good time to look at some of the critical lessons learned from the earthquake and rebuilding process. Broadly speaking, these fall into two categories: technical lessons associated with building and engineeringspecifically and broader leadership lessons.

Building and Engineering Lessons

At the outset, it must be acknowledged that the magnitude of the quake was much greater than that envisaged by all design criteria in place at the time.

With that in mind, the performance of buildings and infrastructure during the earthquake was mixed. At the extreme end, catastrophic loss of life was caused by the collapse of the six-storey Canterbury Television (CTV) building (115 casualties) and the four-storey Pyne Gould Building (18 casualties). The CTV building was subsequently found by a government report to have been constructed of weak columns and concrete which did not meet standards as specified under the New Zealand Building Code at the time of its construction in 1986. In addition, more than 2,000 buildings had to be pulled down.

In sewerage, the Christchurch Wastewater Treatment Plant was badly impacted, while around 528 kilometres of pipe was damaged. Cracking in pipe walls which allowed other liquids to seep into buildings saw some cases of residents arriving at hospitals with gastrointestinal illness. In some cases, pipes collapsed or broke apart.

Apart from that, however, the city's power system was fully restored within hours, roads generally held up well and the airport was largely unscathed. While the number of buildings irreparably damaged was large, overseas experts were amazed at how well others had stood up, according to Canterbury Earthquake Recovery Authority deputy chief executive implementation CERA Baden Ewart.

Perhaps one of the most important lessons learned as far as the initial recovery effort is concerned – though not strictly a building and engineering lesson specifically – revolved around the need to take courageous decisions which may prove to be unpopular, Ewart said.

After the quake hit, an immediate priority revolved around the need to verify and shore up the structural integrity or otherwise of critical buildings and infrastructure, first in the city's centre and subsequently in the suburbs. In order to do that, the CBD was effectively shut down and closed off while engineers went building to building performing initial visual inspections and subsequently more invasive inspections.

This proved to be unpopular, but it ensured that residents were not going to work in buildings which remained standing but were damaged by the quake and were thus structurally unsafe. This was a particularly important consideration as structural damage to many buildings did not become apparent until interior linings were removed and reinforcing steel examined. The closure also allowed for the entire area to be transformed into a work site, demolitions to be conducted in a safe manner and waste to be managed so as to avoid large piles of rubbish being strewn all over streets and ending up contaminating water supplies.

Prior to starting any rebuild, it is also important to pause and reflect not only on how the city should function once rebuilt but also how it can be rebuilt to function more effectively, Ewart said. In Christchurch's case, the CBD remained closed until a new city blueprint had been prepared. Because of this work, the rebuilt city will be more compact and friendly to pedestrians and cyclists, while a dramatic simplification of the city's planning code is allowing for innovation to flourish in terms of new building architecture.

The extent of damage to the sewer system, too, demonstrates the importance of keeping aging infrastructure in good working order, Christchurch chief resilience officer Mike Gilooly said, noting that most of the damage largely reflected the shallowness of the earthquake depth and the pipes being buried relatively deep in the ground.

Perhaps the most important observations and lessons, however, revolve around efforts being made to build stronger with greater resilience.

Notwithstanding the fact that Christchurch already had one of the most stringent building codes in the world prior to the quake, considerable effort is being made to strengthen regulations. At a national level, a strategy was announced in 2013 that requires the seismic testing of all non-residential and multi-residential buildings within five years. All buildings deemed to be earthquake prone were to be placed on a register and strengthened or demolished within 20 years, though the scope and time frames associated with these requirements have since been wound back.

At a localised level, the Building Code has been amended to raise the 'Z' factor associated with the acceptable solution that relates to the structural design for the Canterbury region. This made it a requirement to increase the strength of new buildings within the region to withstand earthquakes to a greater degree.

Second, Christchurch City Council director of building control Peter Sparrow said the performance based nature of the Building Code has allowed for a flourishing of innovative solutions. Steel-based construction has become more extensive, while base isolation and dampening has become commonplace for critical and high value buildings.

Residential areas, meanwhile, have seen more robust designs for foundations and a broad focus upon reparability rather than replacement. In those residential areas where liquefaction was severe, ground stabilisation and strengthening using methods that have been used in road infrastructure are being used to stabilise and strengthen the ground.

In water-based infrastructure, too, significant portions of pressure sewers and vacuum sewers are being installed, Christchurch director of Council Facilities and Infrastructure David Adamson said. The resilience that these add are related to the shallowness of the infrastructure along with the need not to have pipelines on grade. Provided rupture does not occur, he said, it is now envisaged that this infrastructure will be up and running smoothly immediately following any major earth movement.

That leads to a final lesson – that of designing buildings not just for the safety of occupants during earthquakes or other natural disasters but also with regard to post-earthquake recovery. In this respect, a lot of innovation is taking place, Ewart said. Cross members and reinforcing sections are now being designed in such a way that they are affixed to moveable concrete rafts which can allow the building to flex during earthquakes and then quickly re-level using levelling bolts. This means the building is designed not only to protect the safety of occupants during a quake but also to be quickly re-levelled after the event.

"In the past we had buildings which had tended to prioritise safety risk at the expense of the building which in many cases had to come down," he said. "Under current standards, we are dealing with life safety risk and protecting the buildings as well."

"There is lots of innovation in the architecture and design space. Some of the buildings around here are just astounding."

Leadership Lessons

Beyond building and engineering, Ewart said there are important lessons learned with regard to broader leadership issues during the rebuild.

First, it was important not to lose sight of the people and business systems affected, with the business community being given appropriate levels of support and with assistance given toward residents being targeted at helping them gain as much continuity with their regular and everyday lives as possible.

In this regard, a program of temporary wage support for small enterprises who were unable to access their premises was particularly useful as it allowed for the small business community to continue to maintain their workforce and for residents to maintain their employment positions and thus their income throughout the period of disruption. This helped prevent an exodus of population where residents were forced to leave the City in order to seek employment opportunities.

It was also important not to underestimate the physiological and emotional impact of natural disaster upon people's lives. In the case of Christchurch, while early days after the earthquake saw people bond together, Ewart said, the upheaval it has created has taken its toll over time and in some cases has led to alcohol addiction, family violence and/or family breakdown.

Along with the need for the effective provision of emotional support services, Ewart said it is important for those involved in the physical rebuild process to appreciate the extent of the pressures being faced by those with whom they deal, and the need for 'tolerance' in the system when dealing with those people. In this regard, he is particularly disappointed about the problems some residents experienced regarding their insurance, adding that some insurers could have placed less emphasis upon technical terms of the contract (though these are important) and more upon the bigger picture of the well-being of their clients.

Finally, there is the importance of partnership and mutual respect amongst various parties and bodies of government. One aspect regarding Christchurch which could have been managed better, Ewart said, revolves around the relationship between central and local government, with the local authority obviously appreciating the national money coming in but feeling some sense of ambivalence about the idea of national government 'interference' in the rebuild. He said both parties had much to contribute, and had had to learn to respect the contribution each brought to the table.

Overall, Ewart feels the rebuild as a whole has generally been successful, and that criticisms of the project's speed are unwarranted.

"There is a narrative which says that the rebuild of the central city has been slow and taken too long," he said. "(But,) today, 80 per cent of the footprint of the city has got a building being built on it or a plan for a building to be built on it. The businesses are coming back into town.

"We didn't finish the demolitions in town until the middle of 2012. You look at it and that's about three years ago, and it takes about three years from a clear site to design and build some of these big structures.

"On balance, we are doing ok."

(Andrew Heaton / @ourceable, 4 December 2015, https://sourceable.net/what-can-australia-learn-from-the-christchurch-rebuild/#)

☙ ❧

Κοιτίδα του Εγκέλαδου

Πρώτη κατάδυση στα έγκατα όπου γεννιούνται οι σεισμοί

Δεν κατάφεραν να φτάσουν την ίδια την κοιτίδα του Εγκέλαδου, πλησίασαν όμως σε απόσταση μικρότερη των 200 μέτρων: διεθνής ερευνητική ομάδα άνοιξε γεώτρηση σε ένα σεισμικό ρήγμα της Νέας Ζηλανδίας όπου αναμένεται ισχυρός σεισμός. Συμπέρασμα πρώτο, το ρήγμα είναι αναπάντεχα καυτό.

Η γεώτρηση στο Σάουθ Άιλαντ πλησίασε την περιοχή όπου συναντώνται δύο τεκτονικές πλάκες (Πηγή: Julian Thompson/GNS Science)

Αρκετές ακόμα ερευνητικές ομάδες έχουν προσπαθήσει να φτάσουν σε ενεργά σεισμικά ρήγματα σε ΗΠΑ, Κίνα, Ταϊβάν και Ιαπωνία, επισημαίνει ο δικτυακός τόπος του περιοδικού Nature. Όμως, σε όλες αυτές τις περιπτώσεις, οι γεωτρήσεις ανοίχτηκαν μετά την εκδήλωση σεισμών.

Στο νησί Σάουθ Άιλαντ της Νέας Ζηλανδίας, ο στόχος ήταν πιο φιλόδοξος. Σχεδόν 90 επιστήμονες από 12 χώρες προσπάθησαν να μελετήσουν το εσωτερικό του ρήγματος πριν έρθει το επόμενο χτύπημα.

Το συγκεκριμένο ρήγμα σημαδεύει την περιοχή όπου η τεκτονική πλάκα του Ειρηνικού τρίβεται με την ινδο-αυστραλιανή πλάκα. Οι δύο πλάκες παραμένουν κλειδωμένες στη θέση τους από τον τελευταίο ισχυρό σεισμό του 1717, και οι γεωλόγοι εκτιμούν ότι η επόμενη δόνηση έχει ήδη καθυστερήσει.

Το αρχικό σχέδιο προέβλεπε ότι η γεώτρηση θα έφτανε μέχρι το ίδιο το ρήγμα σε βάθος 1.300 μέτρων. Το γεωτρύπανο έφτασε στα 893 μέτρα, οπότε ένας ατσάλινος σωλήνας που εισήχθη στο φρεάτιο για να σταθεροποιήσει τα τοιχώματά του έσπασε και έφραξε την τρύπα, αναγκάζοντας τους ερευνητές να σταματήσουν την προσπάθεια. Κατάφεραν όμως να συλλέξουν δείγματα πετρωμάτων και να εισάγουν στο φρεάτιο ένα καλώδιο οπτικών ινών που λειτουργεί ως θερμόμετρο και σεισμόμετρο.

Η ερευνητική ομάδα εκτιμά ότι έφτασε σε απόσταση μόλις 100 - 200 μέτρων από το ρήγμα, ένα επίτευγμα που τους άφησε όλους ικανοποιημένους.

Το σημαντικότερο εύρημα είναι ότι η θερμοκρασία των πετρωμάτων σε βάθος 830 μέτρων έφτανε τους 110 βαθμούς Κελσίου. Η μέτρηση ήταν μη αναμενόμενη, δεδομένου ότι η θερμοκρασία του υπεδάφους κανονικά ανεβαίνει μόλις 30 βαθμούς για κάθε χιλιόμετρο καθόδου. Το πιθανότερο είναι ότι η θερμότητα είτε αναβλύζει από μεγαλύτερα βάθη ή παράγεται στο ρήγμα λόγω τριβής των πετρωμάτων.

«Είναι πραγματικά ένα αξιοθαύμαστο εύρημα που κανείς δεν είχε προβλέψει» σχολίασε ο Ρούπερτ Σάδερλαντ, επικεφαλής της διεθνούς προσπάθειας.

Στο μέλλον, νέες γεωτρήσεις στο ίδιο ρήγμα θα μπορούσαν να φτάσουν μέχρι το ίδιο το ρήγμα. Όπως λέει ο Σάδερλαντ, «κύριος στόχος είναι να κατανοήσουμε την κατάσταση ενός μεγάλου ρήγματος πριν εκδηλωθεί σεισμός».

Τα ευρήματα θα μπορούσαν να προσφέρουν νέα στοιχεία για τους μηχανισμούς του Εγκέλαδου και ίσως επιτρέψουν μια μέρα την πρόγνωση μεγάλων σεισμών.

Ας ελπίσουμε ότι το ρήγμα του Σάουθ Άιλαντ δεν θα ξυπνήσει πριν προλάβουν οι γεωλόγοι να το φτάσουν.

(Βαγγέλης Πρατικάκης / Newsroom ΔΟΛ, 17 Δεκ. 2015, http://news.in.gr/science-technology/article/?aid=1500046660)

Hellish conditions a scientific gold mine for drilling project

Attempt to reach earthquake source fell short but yielded surprisingly hot rocks

A failed effort to drill through a dangerous fault in New Zealand has served up unexpected scientific results that could help researchers to better understand how earthquakes happen. The project measured temperatures in excess of 100 ºC at just 830 metres below the surface — an exceptionally high value at such a shallow depth.

“This is really a remarkable result and not predicted by anyone,” says Rupert Sutherland, a co-leader of the international project that sought to drill through the Alpine Fault on New Zealand's South Island. The temperature results suggest that a future drill hole in this region might give researchers their first chance to observe directly the most dangerous part of a fault — where large quakes are born and release most of their energy. This high-temperature zone is normally too deep to reach, but it appears to be much more shallow at the drilling site, says Sutherland, a geophysicist at GNS Science, a government-run Earth-science organization in Lower Hutt. He and other project scientists presented the results this week at a meeting of the American Geophysical Union in San Francisco, California.

The thermal measurements are just one set of results coming out of the Deep Fault Drilling Project (DFDP), which involved nearly 90 scientists from 12 countries. The project seeks to study the interior of a large fault as it approaches a major quake. The Alpine Fault marks a gash through Earth’s crust where the Pacific plate grinds past the tectonic block that carries Australia. The plates have been locked together since the last earthquake there, in 1717 — and researchers expect another one to happen soon. The average gap between magnitude-8 earthquakes at the Alpine Fault is 330 years.

The NZ$3-million (US$2-million) project differs from the handful of other attempts to drill deep boreholes into active faults in China, Taiwan, Japan and the United States. In previous cases, researchers invaded faults after a major quake. In the DFDP project, says Sutherland, “the main purpose is to understand the state of a large fault zone before an earthquake appears”.

Ground to a halt

When drilling began in August 2014, researchers planned to reach a depth of 1,300 metres. The goal was to drill through the fault to study the ambient conditions and mineral characteristics at the point where the two plates slip past each other. The team was able to channel down to 893 metres over 5 months. But the project encountered difficulty while attempting to insert a steel tube into the hole to keep it from deforming. A piece of the tube broke off without anybody realizing it, which led to a series of problems that ended the drilling, Rutherford says.

The researchers estimate that they came within 100–200 metres of the actual fault. Although they missed the mark, members of the team say that the project paid off. “It was still a success,” says Weiren Lin, a geophysicist with the Japan Agency for Marine-Earth Science and Technology in Kochi, who is participating in the work. The team extracted rock samples from the zone above the fault, and installed a high-tech fibre-optic cable that can measure temperatures and also function as a seismometer.

After drilling ended and conditions in the hole reached equilibrium, the cable recorded temperatures of more than 110 °C at a depth of 830 metres. The typical geothermal gradient increases at a rate of just 30 °C per kilometre below ground, and a shallow borehole that the team drilled nearby in 2011 had a gradient of twice that. The gradient in the new hole reached as high as 150 °C per kilometre, the researchers reported.

"It has this very high geothermal gradient, and it's very intriguing on that account," says Diane Moore, a geologist with the United States Geological Survey in Menlo Park, California. Despite the problems with the Alpine Fault project, she says, "it's a very impressive body of work that they're getting out of it".

(Richard Monastersky / Nature, 17 December 2015, http://www.nature.com/news/hellish-conditions-a-scientific-gold-mine-for-drilling-project-1.19056)

Νέα δεδομένα για τον σεισμό της Λευκάδας

Στους δικτυακούς τόπους

http://www.edcm.edu.gr/images/documents/RightColumn/LEFK_EQ_2015.pdf και

http://www.elekkas.gr/images/stories/Frontpage/2015_Lefkada/lefkada2015.pdf

μπορείτε να δείτε τα νέα δεδομένα για τον πρόσφατο σεισμό της Λευκάδας.

Ευθύμης Λέκκας
Γραμματεία Προγράμματος Μεταπτυχιακών Σπουδών «Στρατηγικές Διαχείρισης Περιβάλλοντος, Καταστροφών & Κρίσεων»
Εθνικό & Καποδιστριακό Πανεπιστήμιο Αθηνών
Τμήμα Γεωλογίας & Γεωπεριβάλλοντος – Σχολή Θετικών Επιστημών
Τομέας Δυναμικής Τεκτονικής Εφαρμοσμένης Γεωλογίας

ΕΝΔΙΑΦΕΡΟΝΤΑ – ΛΟΙΠΑ

The World's 20 Most Impressive Bridges

From old stone spans to sweeping modern suspensions, bridges have a way of wowing us.

Moving bridges, stone bridges, new bridges, historic bridges, bridges that are global icons, bridges you've probably never heard of—they're all here. We even have one that floats on water and another that carries water. Here are our choices for the 20 most impressive spans around the world.

Golden Gate Bridge, San Francisco

The four-year project to span the Golden Gate strait and connect San Francisco to Marin County culminated in what was the world's longest (4,200 feet) and tallest suspension bridge when this Bay Area landmark opened in 1937. The Golden Gate would keep those records until the 1960s. The Joseph Strauss Art Deco suspension bridge design is famous today in large part because of something a bit out of the norm in the bridge world: color. Golden Gate was painted "International Orange" partly to match the warm coastal surroundings and also to stand out against the horizon for boaters.

Ponte Vecchio, Florence, Italy

You don't walk over the Golden Gate Bridge expecting to find a market or a shopping mall up there. But centuries ago, it was common for shops and even houses to stand one the second story of a bridge. The most prominent example that still exists is probably Ponte Vecchio in Florence, Italy. Rebuilt after a flood in 1345, a 1565 upgrade added a second story to the stone segmental arch bridge spanning the Arno River. It was in the second story that workshops and houses filled the extra space, stretching sometimes wider than the original bridge. Ponte Vecchio is the only one of its kind in Florence that survived World War II.

Magdeburg Water Bridge, Magdeburg, Germany

The water bridge that crosses the Elbe River to connect the Elbe-Havel Canal to the Mittellandkanal becomes the longest navigable aqueduct in the world, at more than 3,000 feet long. Previously, connecting the two canals required a 7.4-mile detour and boat lift into the river. But in 2003 the new concrete water bridge near Berlin changed all that and gave ships a water-filled crossing.

Sydney Harbour Bridge, Australia

The "Coathanger" of steel that crosses the Sydney Harbour has a longer history than it appears. Opened in 1932 after eight years of construction, the steel bridge features six million hand-driven rivets. The extreme sun in Sydney required hinges that could handle the steel expanding and contracting in the extreme temperatures. At 160 feet wide, the bridge was the widest long-span bridge in the world until 2012, and crosses over 3,700 feet with the steel arch 440 feet above the water.

Scale Lane Footbridge, Hull, England

Pedestrians can have some fun in Hull, England, with a swinging pedestrian bridge in what some call the shape of an apostrophe. Designed by McDowell+Benedetti and opened in 2013, the black steel bridge serves as a crossing of the River Hull, but opens to river traffic in an impressive swinging motion.

Millau Viaduct, France

At 1,125 feet, the tallest bridge in the world opened in 2004 and can, at times, soar above the clouds. At over 8,000 feet long, Millau Viaduct spans the Tarn River Valley with seven pillars designed by Lord Norman Foster. To create the bridge in just three years, crews built the towers and then the roadway, which was slid into place atop the towers.

Brooklyn Bridge, New York City

It may have taken 14 years to build, but when the Brooklyn Bridge opened in 1883 to connect Manhattan and Brooklyn, the single span of 1,595 feet suspended by four cables was a sight to behold. It still is. Designed by John A. Roebling and with the construction led by son Washington Roebling and his wife, Emily, the project stands as an enduring symbol for bridge construction the world over. It may have been the 1884 P.T. Barnum spectacle of leading a herd of 21 elephants across the bridge that early on cemented the bridge's popularity. But today, from the 15-.5-inch diameter cables comprised of 5,434 parallel steel wires to the towers built of limestone, granite and cement, everything about the Brooklyn is iconic.

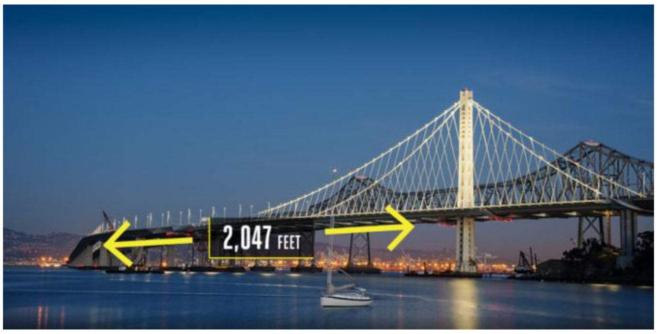
Akashi-Kaikyo Bridge, Japan

The longest suspension bridge in the world measures 12,800 feet across. It opened in 1998 after 12 years of construction. The three-span bridge crosses the Akashi Strait with 190,000 miles of wire cabling the roadways from the two towers. Bridge design had to account for earthquakes, high winds, and harsh sea currents crashing against the towers.

Rialto Bridge, Venice, Italy

The first bridge to span the Grand Canals of Venice, this 15th Century structure by Antonio da Ponte defied the critics of the time and topped some steeped competition—even Michelangelo offered a design for the planned crossing. The peaked Venetian architecture allows for ship passage underneath. The design, which took three years to build, was created 24 feet high and 75 feet wide to allow space for shops along the sides.

Bay Bridge, Oakland



The San Francisco Bay Area is lucky enough to have two internationally reknowned bridges. The new Bay Bridge East Span, a $6.4 billion project, replaced a seismically unstable bridge. It has the world's largest self-anchored suspension span, a 2,047-foot span anchored by a single 525-foot-tall tower that holds a single mile-long main cable containing 17,399 steel wire strands.

State Route 520 Floating Bridge, Seattle

The world's longest floating bridge will be upstaged in spring 2016 when the brand-newState Route 520 Floating Bridge replaces it. The new span, which runs just a few feet to the north of the old Seattle bridge, spans 7,710 feet across Lake Washington and five vehicle lanes wide. The new bridge uses 77 concrete pontoons as the foundation; the weight of the water displaced by the pontoons equals the weight of the structure, allowing it to float. The roadway is elevated 20 feet above the water. A total of 58 anchors secure the bridge.

Pont Jacques Chaban-Delmas, Bordeaux, France

The longest vertical-lift bridge in Europe, at 2,200 feet, has the architectural feat of lifting 252 feet over the Garonne River in Bordeaux, France. The four slender pylons that serve as the vehicle for the vertical lift will light up to signify the current tide—blue for high tide and green for low tide.

Helix Bridge, Singapore

Inspired by the shape of DNA, the Helix Bridge offers Singapore pedestrians 918 feet of architectural intrigue and artistic expression. The bridge in Marina Bay uses multiple styles of steel to curve and sweep, opening up at five points for viewing platforms. The steel tubes serve as the visual spectacle. If straightened and laid end to end, they would stretch 7,380 feet.

Nanpu Bridge, Shanghai, China

The Nanpu Bridge features an impressive seven-lane, 2,500-foot cable-stay component over the Huangpu River. But honestly, it's the four miles of bridge that doesn't cross the river that offers the most intrigue. A circular elevated approach stretches from land and wraps up, bringing vehicles to the height of the crossing in the midst of the heavily congested downtown Shanghai.

Tower Bridge, London

Tower Bridge opened in 1894 on the east side of London after an eight-year project to construct a bridge across the Thames. It's one bridge in two styles—suspension and bascule. The 213-foot-tall towers on either end of a 200-foot central lift span suspend the bridge to the shore on either

side, while serving as the foundation for the bascule span that can raise and lower for ship traffic.

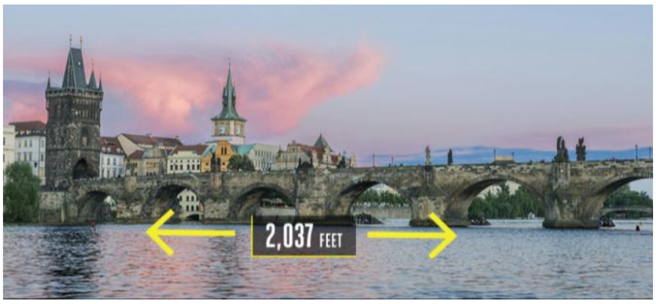
Capilano Cliffwalk, North Vancouver, British Columbia

Next door to the historic Capilano Suspension Bridge, the Cliffwalk opened in 2011 with 700 feet of bridge hanging off a cliff about 230 feet above a canyon. The bridge can handle 100,000 pounds of weight while anchored to the cliff's walls. To make the natural Capilano River canyon even more impressive, sections of the Cliffwalk feature glass-bottom walkways. Not for the faint of heights.

Russky Bridge, Russky Island, Russia

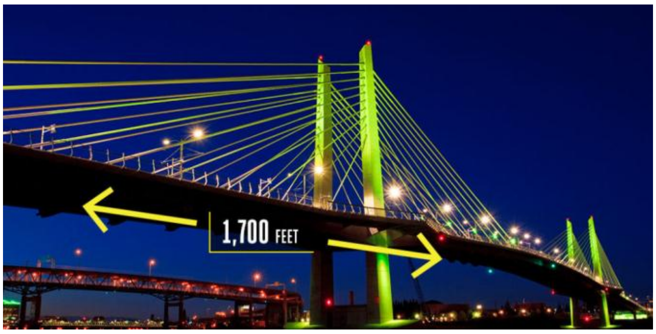
Completed in 2012, the 1,053-foot-tall structure became the world's longest cable-stayed bridge at more than 10,000 feet long, and it has the second-highest pylons (following the Millau Viaduct) in the world. Just don't plan on ever needing to cross the Russky Bridge in your lifetime—it's located in a rural area of southeastern Russia near North Korea, China, and Japan.

Charles Bridge, Prague, Czech Republic



Stone, old, and impressive. The Charles Bridge in Prague crosses the Vltava River in all its Gothic glory. What started in 1357 as a major construction project ended in the early 1400s with a 2,037-foot stone arch bridge connecting Old Town to the Prague Castle area in the Lesser Quarter with 16 arches and an additional 30 decorative statues.

Tilikum Crossing, Portland, Oregon



The first new crossing over Portland's Willamette River since 1973, 1,700-foot Tilikum Crossing opening in September 2015. The structure is remarkable not only for the slender design, with 110.5-foot towers that flow down to the five spans, but also because of what you won't find on the bridge: cars. It's not easy to build a big infrasturcture project in America, much less one that turns away drivers. But only light rail, streetcar, buses, pedestrians, and cyclists are welcome here.

Slauerhoff Bridge, Leeuwarden, The Netherlands

Nicknamed the Flying Drawbridge, for obvious reasons, this small bascule bridge swings sections of 49 foot by 49 foot deck 90 degrees up into the air to allow ships to pass. Two arms swing from a pylon, instead of traditional hinges, for quicker movement.

(Tim Newcomb / Popular Mechanics, 29 December 2015, http://www.popularmechanics.com/technology/infrastructure/g2383/the-worlds-most-impressive-bridges)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

http://www.issmge.org/en/resources/issmge-bulletin/790-vol-9-issue6-december-2015

Κυκλοφόρησε το Τεύχος 6 του 9ου Τόμου του ISSMGE Bulletin (Δεκεμβρίου 2015) με τα παρακάτω περιεχόμενα:

- Research Highlights: Centre for Geotechnical and Materials Modelling, The University of Newcastle, Australia
- Major Project: Design and Case Histories of Large Deep Excavations in Complex Urban Environment in Shanghai
- Report from Member Society: Australian Geomechanics Society
- Conference Report:The 1st International Conference on Geo- Energy and Geo-Environment (GeGe2015) in Hong Kong
- Reports from ISSMGE Foundations Recipients
- Event Diary
- Corporate Associates
- Foundation Donors

No.32, December 2015
https://www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=121&ver=1

Κυκλοφόρησε το Τεύχος 32 (Δεκεμβρίου 2015) με τα παρακάτω περιεχόμενα:

- President's 2016 New Year Address
- 2016 ISRM International Symposium, 29-31 August, Cappadocia, Turkey
- 12th ISRM online lecture by Prof. Ove Stephansson is now online
- ARMS9, Bali, 18-20 October 2016: call for papers
- Workshop "Rock Mechanics and Rock Engineering – Theoretical advances, investigation techniques and de-sign", 3 March 2016, Zagreb, Croatia
- Rock Stress 2016, 10–12 May, Tampere, Finland, an ISRM Specialised Conference
- RockDyn-2, 18-20 May 2016, Suzhou, China, an ISRM Specialised Conference
- Geosafe 2016, 25–27 May, Xi'an, China, an ISRM Specialised Conference
- 2nd ISCSR, 28-30 September, Cartagena de Indias, Colombia, an ISRM Specialised Conference
- VIII SBMR, 19-22 October 2016, Belo Horizonte, Brazil, an ISRM Specialised Conference
- RARE-2016, 16-18 November, Bengaluru, India, an ISRM Specialised Conference
- EUROCK2015 was held in Salzburg, Austria
- The VIII South American Congress on Rock Mechnics was held in Buenos Aires, Argentina
- Workshop on Volcanic Rocks & Soils was held on the island of Ischia, Italy
- ISRM Sponsored Meetings

http://www.geosyntheticssociety.org/Resources/Newsletters/2015-11-igs-news-f1.pdf

Κυκλοφόρησε το Τεύχος 31, No. 3 (Δεκεμβρίου 2015) με τα παρακάτω περιεχόμενα:

- President's Corner
- General Information for IGS Members
- Awarded Work of IGS Award Winners 2014
- Technical Committees IGS-TC
- Announcements of Regional Conferences of IGS
- Announcements of Conferences under the Auspices of IGS
- News from the IGS Chapters and the Membership
- List of IGS Chapters
- Official Journals of the IGS
- Corporate Membership
- IGS News Publisher, Editor and Chapter Correspon-dents

No. 58, December 2015(*), www.ita-aites.org

Κυκλοφόρησε το Τεύχος 58 του ITA@NEWS (Δεκεμβρίου 2015) με τα παρακάτω περιεχόμενα:

- Message from SØREN DEGN ESKESEN, ITA President
- Video and Photos of the awards are available
- Register to attend WTC 2016 in San Francisco
- Muir Wood lecture 2016 will be given by Prof Kaiser

- Think Deep: Planning, development and use of underground space in cities
- ITAtech PRIME SPONSOR Reception & Diner 2015
- Issue 3 of the ITA-CET Committee Newsletter
- Photos of WTC 2015 are now available
- WTC 2015 has been rewarded by the Croatian Forum of Congress Industry
- Eastern ITA Countries met in Minsk
- 13th International Conference Underground Construction & EETC, 23-25th May 2016, Prague
- The British Tunnelling Society Conference and Exhibition , October 11th - 12th 2016
- 2016 China Tunneling and Underground Works Conference (CTUC), 24-25th October 2016

(*) http://www.ita-aites.org/fr/?option=com_acymailing&ctrl=archive&task=view&mailid=125&key=TVGCMfJI&subid=1894-74d7627ed3e51b67271afdd9255b5891&tmpl=component&Itemid=843

www.geoengineer.org

Κυκλοφόρησε το Τεύχος #130 του **Newsletter του Geoengineer.org** (Δεκεμβρίου 2015) με πολλές χρήσιμες πληροφορίες για όλα τα θέματα της γεωμηχανικής. Υπενθυμίζεται ότι το Newsletter εκδίδεται από τον συνάδελφο και μέλος της ΕΕΕΕΓΜ Δημήτρη Ζέκκο (secretariat@geoengineer.org).

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2015 – 2018)

Πρόεδρος	:	Γεώργιος ΓΚΑΖΕΤΑΣ, Δρ. Πολιτικός Μηχανικός, Καθηγητής Ε.Μ.Π. president@hssmge.gr, gazetas@ath.forthnet.gr
Α' Αντιπρόεδρος	:	Παναγιώτης ΒΕΤΤΑΣ, Πολιτικός Μηχανικός, ΟΜΙΛΟΣ ΤΕΧΝΙΚΩΝ ΜΕΛΕΤΩΝ Α.Ε. otmate@otenet.gr
Β' Αντιπρόεδρος	:	Μιχάλης ΠΑΧΑΚΗΣ, Πολιτικός Μηχανικός mpax46@otenet.gr
Γενικός Γραμματέας	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Ταμίας	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr
Έφορος	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής ΤΕΙ Αθήνας gbelokas@teiath.gr, gbelokas@gmail.com
Μέλη	:	Ανδρέας ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής ΕΜΠ aanagn@central.ntua.grn
		Βάλια ΞΕΝΑΚΗ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. vxenaki@edafomichaniki.gr
		Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Ε.Μ.Π. mpanta@central.ntua.gr
Αναπληρωματικό Μέλος	:	Κωνσταντίνος ΙΩΑΝΝΙΔΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. kioannidis@edafomichaniki.gr
Εκδότης	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr

ΕΕΕΕΓΜ
Τομέας Γεωτεχνικής
ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΘΝΙΚΟΥ ΜΕΤΣΟΒΙΟΥ ΠΟΛΥΤΕΧΝΕΙΟΥ
Πολυτεχνειούπολη Ζωγράφου
15780 ΖΩΓΡΑΦΟΥ

Τηλ. 210.7723434
Τοτ. 210.7723428
Ηλ-Δι. secretariat@hssmge.gr ,
geotech@central.ntua.gr
Ιστοσελίδα www.hssmge.org (υπό κατασκευή)

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» Εκδότης: Χρήστος Τσατσανίφος, τηλ. 210.6929484, τοτ. 210.6928137, ηλ-δι. ctsatsanifos@pangaea.gr, editor@hssmge.gr, info@pangaea.gr

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» «αναρτώνται» και στην ιστοσελίδα www.hssmge.gr