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ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

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75

On "Observational Method" in Geotechnical Engineering

Field observations have always been used by engineers to some degree or another. However, according to Peck (1969), the "Observational Method" (OM) in geotechnical engineering is a term having a specific and restricted meaning. In its complete and ultimate form the Observational Method provides a distinct and possibly more economic and safe approach to design. The origin of the OM can perhaps be attributed to Terzaghi (1943), as the "learn-as-we" go method, but a significant step in the development of the method was the 1969 Rankine Lecture presented by Ralph Peck.

According to Peck (1969), a vast amount of effort (and money) goes in geotechnical engineering into obtaining only roughly approximate values for the physical constants that are used in our simplified models. By simplified, I mean that we always make simplifications to some degree or another (some times more, some less), even in very complex analyses. Many variables, such as the degree of continuity, pore water pressure conditions, and many other details may still remain unknown after a design is complete. **Therefore, the results of computations are nothing more than just working hypotheses, which could be subject to confirmation or modification during construction**.

(συνέχεια στην σελίδα 3)

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

Θερμοπίδακας (Geyser) στην Ισλανδία, λίγο πριν εκραγεί

Λίμνη Erta Ale από λάβα στην Αιθιοπία, ένα ενεργό ηφαίστειο

Ατόλη Ειρηνικού Ωκεανού

ΑΡΘΡΑ

On “Observational Method” in Geotechnical Engineering

David Oliveira, Principal Geotechnical Engineer at Coffey

I posted these notes quite sometime ago in the **Underground Geomechanics LinkedIn group** and thought I could bring it up again.

Field observations have always been used by engineers to some degree or another. However, according to Peck (1969), the “Observational Method” (OM) in geotechnical engineering is a term having a specific and restricted meaning. In its complete and ultimate form the Observational Method provides a distinct and possibly more economic and safe approach to design. The origin of the OM can perhaps be attributed to Terzaghi (1943), as the "learn-as-we" go method, but a significant step in the development of the method was the 1969 Rankine Lecture presented by Ralph Peck.

It is quite common the use of the term Observational Method in design when in fact the designers were only specifying a monitoring/instrumentation program. I should include myself in this misuse of the terminology sometimes. No doubt, a monitoring program allows us to make more targeted, improved or detailed observations but it does not necessarily mean that the whole design and construction follows the restricted meaning of the OM. To better understand the differences, it is perhaps worthwhile to revisit some of Peck’s words and the concept of a “predefined design”.

According to Peck (1969), a vast amount of effort (and money) goes in geotechnical engineering into obtaining only roughly approximate values for the physical constants that are used in our simplified models. By simplified, I mean that we always make simplifications to some degree or another (some times more, some less), even in very complex analyses. Many variables, such as the degree of continuity, pore water pressure conditions, and many other details may still remain unknown after a design is complete. Therefore, the results of computations are nothing more than just working hypotheses, which could be subject to confirmation or modification during construction.

For coping with the inevitable uncertainties, two approaches are typically adopted for a single, fully developed design that has no intention of being modified during construction: 1) to adopt an excessive factor of safety, or 2) to make assumptions in accordance with general, average experience. Peck (1969) stated that the designer who has used the latter procedure has usually not suspected that he/she was actually taking a gamble. Well, the proof perhaps lies in the fact that we still too often (?) see some significant incidents. In summary, Peck (1969) states that the first method is wasteful, the second is dangerous. In these two approaches, instrumentation and monitoring plays a more passive role, typically only to provide some degree confidence to third party checkers or authorities. This traditional design approach is termed as “predefined design” based on the CIRIA Report 185 (Nicholson et al. 1999).

In contrast, the monitoring in the OM plays a more active role by allowing planned modifications to be carried out within an agreed contractual framework. Therefore, the OM, as we understand today, provides a third method. The procedure according to Peck (1969) is as follows: 1) Base the design on whatever information can be secured. 2) Make a detailed inventory of all the possible differences between reality and the assumptions. 3) Then compute, on the basis of the original assumptions, various quantities that can be measured in the field. For instance, if assumptions have been made regarding water pressure beneath a structure, compute the pressure at various easily accessible points, measure it, and compare the results with the design forecast. Or, if assumptions have been made regarding stress-deformation properties, compute displacements, measure them, and make a similar comparison. 4) On the basis of the results of such measurements, gradually close the gaps in knowledge and, if necessary, modify the design during construction. In summary, the complete application of the OM embodies the following ingredients (Peck, 1969):

1. Exploration sufficient to establish at least the general nature, pattern and properties of the deposits, but not necessarily in detail.

2. Assessment of the most probable conditions and the most unfavourable conceivable deviations from these conditions. In this assessment geology often plays a major role.

3. Establishment of the design based on a working hypothesis of behaviour anticipated under the **most probable conditions**.

4. Selection of quantities to be observed as construction proceeds and calculation of their anticipated values on the basis of the working hypothesis.

5. Calculation of values of the same quantities under the **most unfavourable conditions** compatible with the available data concerning the subsurface conditions.

6. Selection in advance of a course of action or modification of design for every foreseeable significant deviation of the observational findings from those predicted on the basis of the working hypothesis.

7. Measurement of quantities to be observed and evaluation of actual conditions.

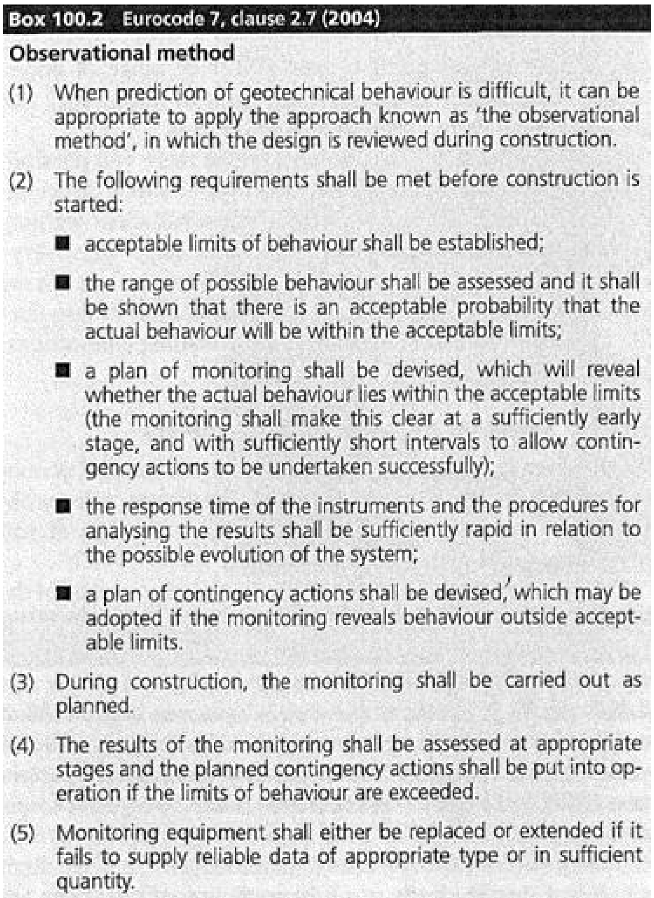
8. Modification of design to suit actual conditions.

Peck (1969) mentioned that under unexpected developments during a construction or the threat of a failure, perhaps most engineers would instinctively adopt such a procedure. The mere observation of events, such as the measurements of settlements or lateral movements, often suggests remedial measures that may prove to be successful. Yet the results are sometimes disappointing and occasionally disastrous because the observations do not constitute part of a well-considered program encompassing all the applicable steps in the complete “learn as-you-go” (Terzaghi, 1943). In summary, as discussed above, pure monitoring is not the same as an OM.

The above steps are summarised in more recent documents as the Eurocode 7. Figure 1 is a scan of clause 2.7 as presented in the ICE Manual of Geotechnical Engineering (ICE, 2012).

<u>But why is the OM possibly a more economic and safe approach to design??</u>

It is important to highlight that the objective of the OM is to deal with uncertainties, and not necessarily reduce factors of safety when assessing a potential collapse or an ultimate limit state. As a result, to put some thoughts into the question above, we should perhaps first explore why the words “**most probable conditions**” and “**most unfavourable conditions**” were highlighted in bold above.



Box 100.2 Eurocode 7, clause 2.7 (2004)

Observational method

(1) When prediction of geotechnical behaviour is difficult, it can be appropriate to apply the approach known as 'the observational method', in which the design is reviewed during construction.

(2) The following requirements shall be met before construction is started:

- acceptable limits of behaviour shall be established;
- the range of possible behaviour shall be assessed and it shall be shown that there is an acceptable probability that the actual behaviour will be within the acceptable limits;
- a plan of monitoring shall be devised, which will reveal whether the actual behaviour lies within the acceptable limits (the monitoring shall make this clear at a sufficiently early stage, and with sufficiently short intervals to allow contingency actions to be undertaken successfully);
- the response time of the instruments and the procedures for analysing the results shall be sufficiently rapid in relation to the possible evolution of the system;
- a plan of contingency actions shall be devised, which may be adopted if the monitoring reveals behaviour outside acceptable limits.

(3) During construction, the monitoring shall be carried out as planned.

(4) The results of the monitoring shall be assessed at appropriate stages and the planned contingency actions shall be put into operation if the limits of behaviour are exceeded.

(5) Monitoring equipment shall either be replaced or extended if it fails to supply reliable data of appropriate type or in sufficient quantity.

Figure 1 – OM in Eurocode 7 (after ICE, 2012).

Let's assume that, for the design of an underground excavation, either a civil tunnel or a major mine development/access, a sufficient number of boreholes, rock classifications and testing (item *a*) were carried out such that statistical distribution of design parameters as depicted in Figure 2 below could be developed (item *b*).

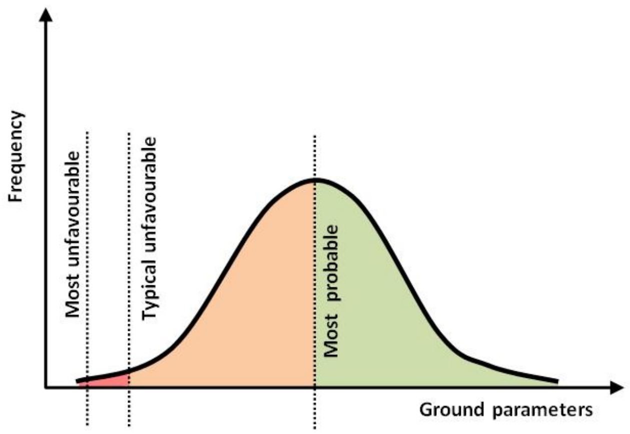


Figure 2 – Idealised normal distribution of design parameters.

The "most probable condition" is assumed to be a set of parameters that represent the probabilistic mean of all the data, although a degree of engineering judgment must also be used in assessing these data in order to take into account the quality. The "most unfavourable condition" is the set of parameter that represents 0.1% fractile of the data and this would represent the worst credible value that may occur in practice. Another set of parameters that can be defined is the typical unfavourable condition which would ideally result in the prediction of the upper 5% fractile of the quantity affecting the occurrence of the limit state (i.e. either near collapse or a serviceability state). Note that this may not be the same as the characteristic value representing the 5% fractile of the data as used in structural engineering.

Assuming that we have assessed an acceptable risk, i.e. the product between consequence and likelihood, we have established an acceptable probability of failure. If we design based on the most unfavourable set of parameters and apply a similar factor of safety that we would for the most probable condition, we will fall in the first category described by Peck (1969), i.e. a wasteful or over-conservative design (Figure 3). On the other hand, designing for the most probable decreases the degree of conservatism and would be more economical (Figure 4). However, as Peck (1969) stated, it is a gamble to some extent, otherwise there would be no need for the word "probable". By adopting the OM and a working hypothesis of the most probable conditions (item *c*), one could say that it is at least a risk-controlled "gamble". If we properly monitor the behaviour during construction (items *d* and *g*), contingencies may then be put in place if we realise that our gamble has failed (items *e*, *f* and *h*).One could argue that these two cases, "probable" and "unfavourable", should not have the same factor of safety. If this is done consciously it can indeed reduce the differences, i.e. if one figures out what level of risk or perhaps probability of failure (PoF) he or she is willing to accept then a lower FoS for the "most unfavourable" condition could perhaps be adopted. It is important to note, however, that we often implicitly define a PoF through a commonly accepted FoS without really investigating probabilities, i.e. we often assume that for a FoS=1.5 or 2 the PoF is low. Moreover, factors of safety are often linked to a desirable serviceability limit or allowable strength, thus, such condition also needs to be satisfied if the FoS is to be lowered (but with an acceptable PoF still). Nevertheless, ground conditions could still differ from our expectations so monitoring would still be a necessity, particularly in the case of a lower FoS.

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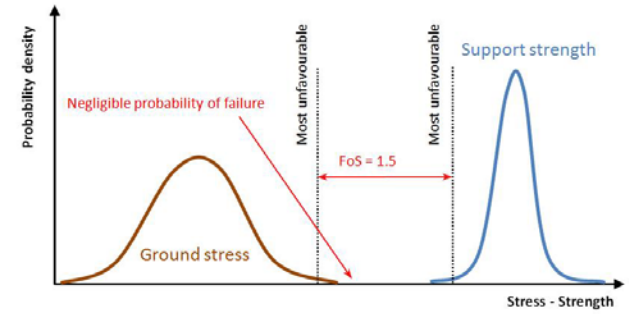

Figure 3 – Idealised design based on most unfavourable condition and a target FoS=1.5.

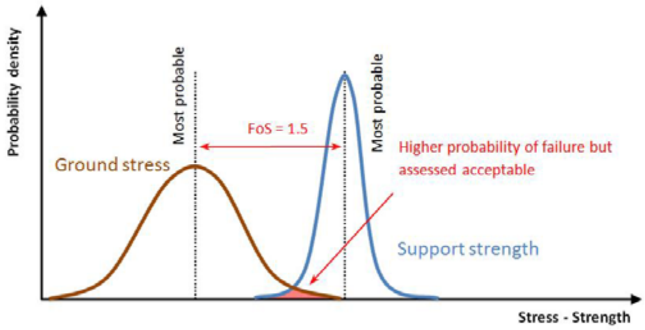

Figure 4 – Idealised design based on most probable condition and a target FoS=1.5.

One could argue that for the two example cases above, "probable" and "unfavourable", should not have the same factor of safety. If this is done consciously it could indeed reduce the differences, i.e. if one figures out what level of risk or perhaps probability of failure (PoF) he or she is willing to accept then a lower FoS for the "most unfavourable" condition could perhaps be adopted. It is important to note, however, that we often implicitly define a PoF through a commonly accepted FoS without really investigating probabilities, i.e. we often assume that for a FoS=1.5 or 2 the PoF is low. Moreover, factors of safety are often linked to a desirable serviceability limit or allowable strength, thus, such condition also needs to be satisfied if the FoS is to be lowered (but with an acceptable PoF still). Nevertheless, ground conditions could still differ from our expectations so monitoring would still be a necessity, particularly in the case of a lower FoS.

The question that remains is, as safety factors are not measurable, how can we assess whether our safety margins were appropriate or not?

Well, the ground will express itself in quantities that are measurable. For example, changes in stresses (measured by strains), displacements and overbreaks, are all quantities that can be measured to some extent and compared with the design predictions. Figures 5 and 6 depict the increase in predicted roof displacements for the different sets of parameters. Note that throughout Figures 3 to 6, different ranges of parameters have been highlighted with different colours. This is to help visualise that by assessing the most probable condition and typical unfavourable conditions, we are implicitly already defining trigger values for our monitoring program according to a traffic-light system - Green, Amber and Red.

Figure 6 also illustrates how these trigger values develop with time at a particular location, in this case with respect to a rate of tunnel advance. Developing such trigger values during design and plotting the actual measurements during construction assist us in gradually closing the gaps in knowledge and, if necessary, modify the design during construction. Note, however, the importance of knowing beforehand what to do as we move from an amber zone do Red zone as some of the possible solutions may no longer be possible at later stages.

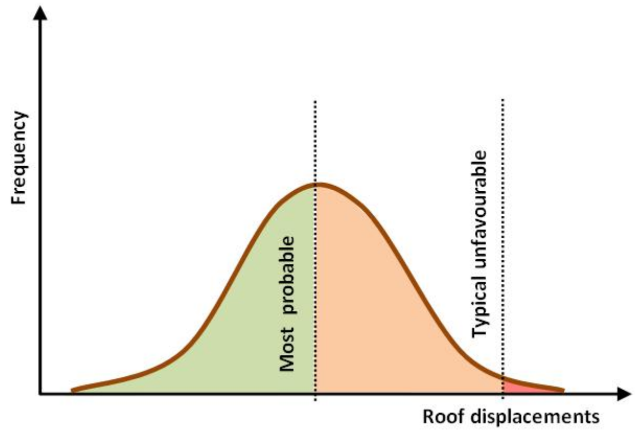

Figure 5 – Idealised displacements distribution predicted for different ground parameters.

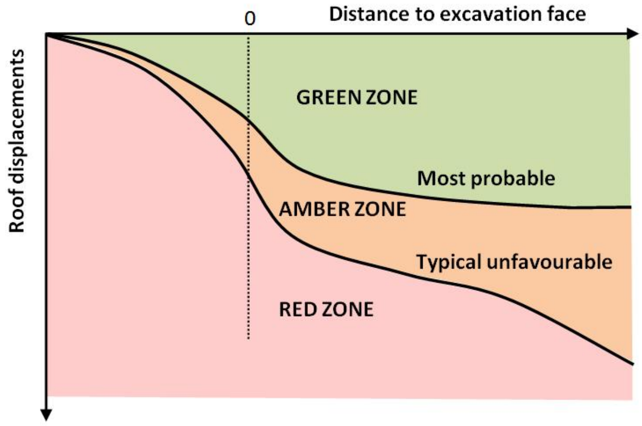

Figure 6 – Tunnel longitudinal displacement profile (LDP) for different ground assumptions.

Criticism and modifications to Peck's OM framework

Kovari and Lunardi (2000) present some criticism to the OM framework presented by Peck (1969). The authors particularly criticise the use of the term "condition" which was deemed unsuitable as a basis for a planned procedure (method). They argue that it is a false impression that field measurements can only be employed meaningfully within the framework of the observational method. The authors also state that, in tunnelling, there is a whole range of problems for which field measurements are of considerable value without limiting ourselves to Peck's ideas.

To further elaborate on their point of view, Kovari and Lunardi (2000) present a case history from Italy: "The use of monitoring to pass under the Mugello Motor Racing Circuit (Firenzuola tunnel)". Predictions of tunnel behaviour with respect to face extrusion were presented based on triaxial testing (Figure 7) which were then used for setting monitoring trigger values. Field measurements indicated that the alarm threshold was exceeded (Figure 8) which resulted in a series of back-analyses for re-calibration of the design parameters (Figure 9) and reassessment of the support design.

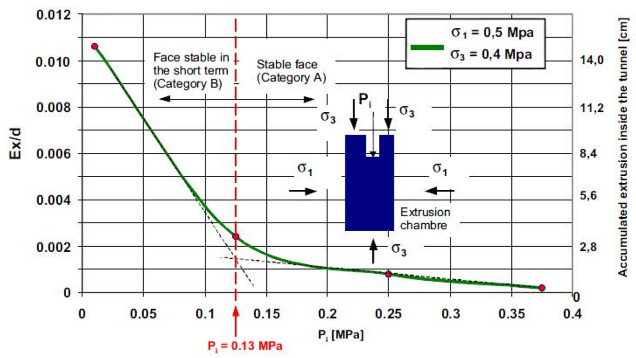

Figure 7 – Prediction of the behaviour using triaxial extrusion tests (after Kovari and Lunardi, 2000).

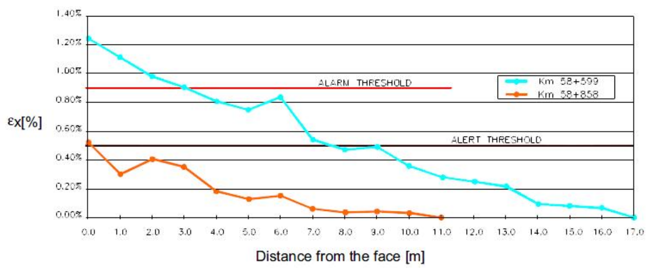

Figure 8 – Measurements of face extrusion during construction (after Kovari and Lunardi, 2000).

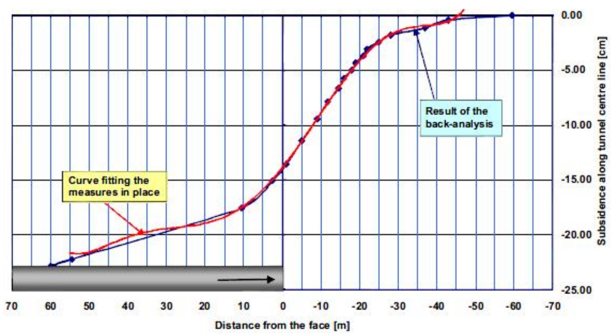

Figure 9 – Re-calibration of prediction using an axisymmetric model (after Kovari and Lunardi, 2000).

Based on the above, it is unclear what Kovari and Lunardi (2000) meant exactly by "limiting ourselves to Peck's ideas" as one could argue that they have used a very similar framework to that of Peck (1969).

The CIRIA report 185 (Nicholson et al. 1999) proposed a slight change to Peck's approach. As discussed above, Peck (1969) adopted the "most probable" design which could then be reduced to "moderately conservative" soil parameters, where triggers were exceeded. The moderately conservative parameters is not a precisely defined value but a cautious estimate which are worse than the probabilistic mean but not as severe as the most unfavourable - perhaps the typical unfavourable condition described above which results in the upper 5% of the values affecting the limit state (e.g. the 5% most critical displacements depicted in Figure 5) or something between that and the most probable . The CIRIA definition on the other hand considers a "safer" approach to design by adopting a "progressive modification" of the design starting with the design based on moderately conservative parameters, and then reverting to most probable conditions through field observations. As a result, CIRIA 185 defines the OM as:

"*The Observational Method in ground engineering is a continuous, managed, integrated, process of design, construction control, monitoring and review that enables previously defined modifications to be incorporated during or after construction as appropriate. All these aspects have to be demonstrably robust. The objective is to achieve greater overall economy without compromising safety*."

Not closing the gaps in knowledge

One recent case study that will be considered here as an example of gaps in the use of the OM: the collapse of the Pinheiros Station Cavern in Brazil in 2007. As it would normally be expected, there was (or still is) a lot of debate with respect to the main causes of the failure as discussed by IPT (2008), Barros et al. (2008) and Barton (2009a, 2009b). While this is important, what is still quite intriguing is the discussion about the behaviour of the cavern as observed through some of the monitoring data during construction (e.g. Figure 10).

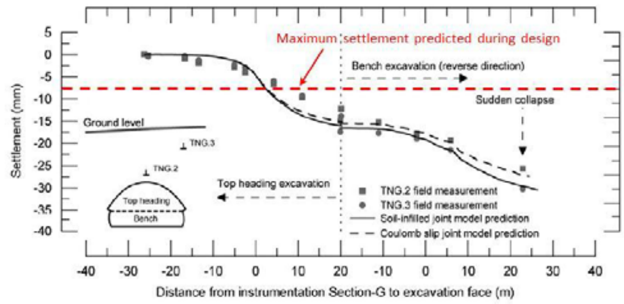

Figure 10 – Settlement predictions with tunnel advance at instrumentation section G, 27 m away from shaft (modified from Indraratna et al., 2010).

The total crown displacement at the time of the collapse was approximately 30 mm which could be considered by many as a common deformation for such a large cavern. Based on such understanding, it appears that the design was not thoroughly re-assessed or at least not with enough details. However, the original design predictions anticipated only 7 mm of total crown deformation, i.e. a difference of over 400% from the observed value. Moreover, most of the deformation was expected to occur during or immediately after the excavation of the top heading with little deformation expected during bench excavation. Nevertheless, the monitoring data showed that significant deformation was occurring during bench excavation indicating that something was missing in the original design and had to be re-assessed.

Indraratna et al. (2010) analysed the failure mechanism proposed by Barton (2009a, 2009b) and indicated that in clay-infilled rock joints, very small differences in the shear displacement along the joints could result in more pronounced detachment of rock wedges which could in turn further load the tunnel lining.

The example above indicates that the gaps in knowledge between the design and the actual field behaviour as discussed above were not closed and even though the design predictions were significantly less than the observed/measured displacements there was no further investigation. This occurred, perhaps, based on the argument that the displacements were "normal" for such tunnels. However, it did not warrant the lack of investigation of the potential impact on other elements of the design, e.g. overloading of the ground support, and consequently the design assumptions.

Such issue seems to be far more important than if the problem could have been foreseen in the design or not. The final consequence was that by the time a decision was made to further investigate, in fact reinforce the tunnel walls, it was too late, and there was a collapse that killed 7 people who were just passing by at the surface.

A final caveat

It should be noted that the OM is not an approach to simplify the design by being optimistic and to wait to see what happens during construction, dealing with any issues later. The OM is not a "way out" for poorly investigated and designed projects. Perhaps, it is fair to say that the proper application of the OM requires even more thorough investigations, assessments and analyses than a "predefined design". Therefore, a greater effort (time and money) may be required during the initial design phase to achieve the economic and safety benefits of the OM.

A few of the many important aspects that may impact the successful application of an OM and explain why the OM may require more engineering are:

1. Knowledge of the stress-strain behaviour and hydrogeological condition of the ground.

2. Identification of the relevant failure mechanisms and the onset of instabilities.

3. Definition of acceptable levels of deformations for both ultimate and serviceability limit states which be used to establish trigger levels (e.g. the traffic light system).

4. Recognition of the nuances between the behaviours in the short-term and in the long-term , so that there is no false impression of stability in the short term.

5. Good communication between geotechnical engineers, structural engineers and construction team.

6. Clear and comprehensive monitoring plan which consists of the proper definition of where, how and how often readings need be taken, the required actions and the timeframe in case the trigger values are exceeded, the appropriate chain of communication including the personnel involved.

****** This work is the opinion/viewpoint of the author only and does not reflect the opinion or position of any third party or entity.**

Acknowledgements

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Italy, America and Indonesia struggle with soft soils

Pjotr Van Lenteren

The subsidence of soft soils such as peat is a global problem. California, Italy and Indonesia have developed their own ways of dealing with the consequences of land subsidence. "Sound science is the only way to convince people."

For anybody who works with agriculture and homes in peat areas, there is no escaping the challenges: land subsidence, flood risks and greenhouse gases. The Italian Po Valley, Sacramento Delta in California and the coastal zones of the Indonesian islands are all facing the same difficulties, but they have adopted different approaches. How can local scientists get the topic onto the agenda, how are they trying to counteract the effects of land subsidence, and what can other countries learn from them?

Po valley: a fine balance

Everyone knows that Venice can just keep its head above water, but the real problems are found where tourists don't go, in the Marghera, the agricultural and industrial area around the city. Here, the peat ground is located a number of meters below sea level. Until the 1970s, this was caused by deep groundwater being pumped to the surface. After an aqueduct was installed, land subsidence continued, but now as a result of the drainage of agricultural land. "This type of subsidence is not as fast, but it is much more difficult to stop" argues Pietro Teatini of the University of Padua. "If we pump too much, the land subsides; if we pump too little, there are floods." Water authorities in the Po valley have to meet the challenge of striking a fine balance in both natural and political terms. "It has been agreed with farmers to plough 30 cm rather than 70 cm. That is already an enormous help."

Land subsidence in areas with soft soil, like those in and around Venice, can, in combination with poor foundations, result in the subsidence of historic buildings, as here in the case of the Santa Maria Gloriosa del Frari.

California: convincing farmers and the public

In Venice, the problems are easy for all to see; in the USA, there are areas where it is much more difficult to convince the government and business about land subsidence. "America is affected by all types of land subsidence", explains Devin Galloway of the US Geological Survey, "but the most frequent solution is to move the problem. There are plenty of uninhabited areas." In the Sacramento Delta near San Francisco, farms are located on peat islands between busy river arms. "If you stand at the bottom of the bowl, you look up at sea-going vessels as they sail by." Even here, it hasn't proven easy to raise awareness of the problem among local people and farmers: the farmers themselves live safely on higher land. "On top of that, the economic stakes are considerable: one third of the USA's table vegetables are produced here." Forward-looking areas are trying to buy out farmers and submerge the land in question. Sedimentation creates new land. "That sounds good, but the process is not fast enough and we are struggling with the salinisation of the groundwater. We do hope it will buy us time so that we can find better solutions."

Indonesia: palm oil and paper pulp

Not many people associate the tropical coastal zones of Indonesia and Malaysia with peat. But that is precisely what you find below the jungles, three quarters of which have already been cut down: 25 million hectares, roughly the surface area of Great Britain. Until the 1990s, the main industry here was forestry, with the selective felling of sustainable timber such as meranti. "Since they started producing palm oil and pulp for paper, things have taken a turn for the worse", explains Aljosja Hooijer of Deltares. "Drainage leads to the loss of peatland and these areas are now facing more and more floods, with the country's emissions of greenhouse gases almost matching the USA and China." Due to thelackof proper maps showing peat and land levels, it is easy to question whether the problems are real. At the moment, environmental organisations and business are the main actors pushing for more sustainable approaches, financing research into the loss of peat and land subsidence, and drawing up accurate maps using aeroplanes and laser technology. The data make it possible to predict how fast flooding will increase, and what can still be done by reducing drainage. "But it continues to be a difficult discussion: should a company or a government agency pass on profits that can certainly be made this year for the sake of more sustainable, but lower, profits in ten years from now? The only way to convince people is by doing good science, and producing sound data."

DELTA life, DELTARES MAGAZINE, No. 3, February 2015, pp. 14-15

Geotextiles Flex Their Muscle
Geotextile Reinforcement Applications

Chris Kelsey

In the March/April 2014 issue of *Land & Water*, a general history of geotextile developments over the past 40 years was published. This was part of the magazine's 40-year celebration series. One of the sections of that article addressed the increasing strength in geotextile materials.

Here, we look a bit further at how geotextiles are being utilized in reinforcement aAnd soil stabilization applications.

Transforming the field

The Terzaghi Lecture is one of the most prestigious lectures in geotechnical engineering. In 2008, Dr. J.P. Giroud delivered the lecture and emphasized that geosynthetics were the most important development in civil engineering in the 20th century. Giroud, as many *Land & Water* readers know, coined the terms "geotextile" and "geosynthetic" in a seminal lecture in 1977 (Paris) to describe the materials that had already been in use widely but which had not yet been formalized in terminology.

Dr. Bob Holtz, who was selected to deliver the 2010 Terzaghi Lecture, echoed Giroud's observation about the importance of the invention of geosynthetics; and, Holtz highlighted how geosynthetics had been the first truly new class of construction material to be developed in a 100 years.

Geotextiles were the first of the geosynthetics to find civil application. Two storms kicked off the innovation: severe North Sea flooding in 1953 in the Netherlands and a 1957 storm off Florida's Atlantic coast.

In the Dutch case, it prompted Royal Ten Cate to pioneer polyethylene fiber geotextiles specifically for civil use. The Dutch Delta Works (one of the Engineering Wonders of the Modern World) was built in the early 1960s with these materials.

The 1957 Atlantic storm caused severe beach erosion at the home of the president of an American textiles company, Carthage Mills. That spurred the company to develop synthetic filter fabrics, and made them the first geotextile company in the US. You can find the legacy of this innovation commonly installed under riprap.

The early geotextiles were incorporat ed swiftly into designs by engineers, who recognized the simple engineering functions the materials could play in lieu of much thicker aggregate layers and filters or heavier materials that were commonplace in traditional construction. (General acceptance and standardization, of course, was a little further off.) Multiple companies entered the marketplace and helped usher in a wide range of material constructions in order to enhance filtration, drainage, separation, and reinforcement characteristics of what would become known as geotextiles.

Reinforcement

Soil reinforcement and stabilization has steadily been a use of geotextiles, though they are not always thought of in the larger construction field as reinforcement materials. Geogrids have been designed more exclusively for reinforcement, and, thus, have earned more renown for that function. Geotextiles are multi-functional.

Also, in part, the "fabric" or "textiles" background of geotextiles has been a challenge. When people think of them as fabrics, it inspires thoughts of less complex, weaker materials. Clothes are made of fabric. You wouldn't build a bridge on clothes.

However, in the 1990s, the concept of reinforcement with "fabrics" was entertainingly taken on by Bob Barrett, who had been an early adopter and developer of reinforcement designs using a variety of materials.

A new wave of geotextiles, such as TenCate's Mirafi® RSi series, are characterized by exceptional strength and reinforcement performance. Photo by TenCate Geosynthetics Americas.

Barrett used jersey barriers, standard soil, and layers of bed sheets to show how structures could be built on even extremely weak fabric. It emphasized, by contrast, what the more highly engineered geotextiles could do as efficient, cost-effective soil-reinforcement materials.

A historical video of that experiment can be viewed at www.gcswall.com.

The act of separating soil layers with a geotextile is an act of reinforcement or stabilization. Geotextiles have tensile strength. Lower strength silt and clay are thus improved by insertion of a geotextile layer.

For roads, the weight of vehicles and the rotating force of passing wheels can induce pumping of aggregate layers below. Fine and coarse-grained aggregate may then mix. Rutting or cracking follows. The installation of a geotextile separator prevents that mixing of dissimilar layers. The drainage/filtration capacity of the geotextile may also be selected to prevent build up or infiltration of water into subgrades.

In the construction of a geosyntheticreinforced soil (GRS) bridge abutment, the closely spaced layers of geotextile encloses the compacted soil layers, which, with embedment, improves the bearing capacity of the system and prevents water seeping down to and building up at the bottom of the GRS structure.

Ultimately, it's difficult to absolutely separate out functions of a geotextile because the material is so multi-functional. And, in most designs, it's fair to say the geotextile performs more than one function even if it is specified for a single one. Reinforcement, though, deserves more recognition.

GRS-IBS

The Geosynthetic-Reinforced Soil – Integrated Bridge System (GRS-IBS) deserves special mention. It has been promoted by the Federal Highway Administration (FHWA) and various county engineering bodies for more than 15 years; but it has been mostly in the past six years that it has really received greater attention. The development of a strong record of projects and historical data on cost and performance has helped, and it is now supported by videos and regular lectures and training courses by FHWA personnel and county engineers, such as through LTAPs (Local Technical Assistance Programs).

Seen here: setting the bridge directly atop the geosynthetic-reinforced soil without any additional structural elements needed. Photo by Warren Schlatter, Defiance County (OH) Engineers Office.

The system represents one of the clearest examples of the benefits offered by geotextiles in reinforcement designs.

GRS-IBS has had an extraordinary impact on the cost-effectiveness of small bridges. It has made it far more feasible for counties and municipalities to improve structures in conjunction with or independent of federal funds. Reinforcement geotextiles have been critical here. The layers are spaced closely (e.g., <12 inches) within conventional compacted soil and with standard block facings. The superstructure is placed directly on top of the GRS abutment without a joint. The transition between the roadway and the bridge deck comes without a bump.

Subsequently, an adjacent box beam or spread box beam bridge with spans over 30 feet can be built in less than 1.5 months and for less than $100,000.

Specialized labor is rarely required. Less complicated equipment can been used and far less land is disturbed. GRS-IBS uses simple load-bearing principles, easy-to-follow construction techniques, and reinforcement geosynthetics to turn what used to be a many months process into weeks, and to turn construction phases that used to take weeks into those that take only days.

In the Field

The two companies mentioned above—Carthage Mills and TenCate—are still both well-involved in the field of geosynthetics.

Carthage Mills offers a polypropylenebased, woven geotextile line (FX® High-Performance) and polyester woven (FX®High-Strength) for reinforcement applications. These include MSE walls, base and slope reinforcement, void-bridging, embankments on soft soils, etc. www.carthagemills.com.

TenCate's Mirafi® RSi series offers an exceptional tensile modulus for highstrength reinforcement. MSE walls, road and railway base course reinforcement, runway design, and other applications utilize this woven geosynthetic. Enhancing wicking properties are also available with these materials. www.tencate.com.

A few other companies and products include:

HUESKER inc. offers multiple products for reinforcement. Robutec® is a high-modulus, low-creep, alkali-resistant woven material. Ringtrac®, uniquely, is a reinforcement geotextile used as a cylindrical reinforcement sleeve, such as for geotextile-encased columns (GECs). www.huesker.com.

Polymer Group, Inc.'s heat-bonded nonwoven TYPAR geotextile was one of the first products on the market. Developed in the 1960s by DuPont, the line has decades of project records and data in road reinforcement. www.typargeosynthetics.com.

The woven Geotex® line from Propex includes varieties for moderate soil reinforcement (e.g., embankments, slopes) and higher-strength applications (e.g., lagoon closure). www.geotextile.com.

A range of geotextile material data from throughout the industry is published openly on www.geosindex.com.

Continuing Development

While geotextiles are often used as "commodity" products, such as for cushioning layers within a more expensive barrier system (e.g., landfill cell construction), they continue to be a source of innovation as manufacturers achieve new strengths and filtration/drainage properties; and, as designers find ways to utilize the multiple functions of geotextiles to achieve stronger project economics and long-term performance.

GRS bridge abutments, generally built with geotextile reinforcement, have yielded substantial time and cost savings in small bridge construction. Photo by Warren Schlatter, Defiance County (OH) Engineers Office.

Chris Kelsey is the editor of Geosynthetica (www.Geosynthetica.net), an online publication dedicated to geosynthetics and geotechnical engineering.

Land & Water, January/February 2015, pp. 15-18.

World class achievements as dams reach new heights

Ted Warren provides an update on development of three of the world's largest hydroelectric dams.

A number of major new hydroelectric and dam projects are under construction or have recently been completed throughout the world, with some of these dams reaching heights approaching 300m tall. A detailed update is provided below on the development at three of these large dam projects along with respective and recognised world class achievments.

Gibe III, Ethiopia

The Gibe III dam and associated hydroelectric project is located on the Omo River in Southern Ethiopia in a very remote region. When completed, Gibe III will be the largest and the tallest RCC dam in the world. The RCC placement operations started in late December 2011, pre impoundment started in August 2014, with early impoundment starting in early 2015.

The project has overcome some very challenging conditions from a design standpoint as well as a construction standpoint. Its size alone makes the project implementation very difficult in itself. Adding to the difficulties is the natural terrain, steep abutments (in some places 45 degrees or steeper), and extreme hot weather conditions.

One of the greatest challenges that was overcome by the contractor Salini-Impregilo S.p.A was the amount of RCC that had to be placed in the dam body to meet the demanding "fast tracked" schedule. The RCC placement operation was well planned and started off well with many ideas from the management team implemented during construction. During the most difficult and critical time in the early stages of the construction operation another great challenge that needed to be overcome was the enormous foundation footprint for which the structure resides it's mass. This involved the cleaning, approval, and final preparations of the geological and site specific features that had to be prepared in accordance with strict specification considering the size of the dam.

During the first year the contractor placed just over 1Mm3 of RCC in the dam. Over the next 24 months the contractor placed more than 5Mm3 of the 6.1Mm3 required for the dam. During this period the contractor averaged more than 140,000 m3 per month, with a peak month of 250,809m3 in August 2013, which is a remarkable achievement in itself.

First RCC placed at Gibe III on 18 December, 2011

On December 11th through December 12th 2014 the Salini-Impregilo team placed 18,519m3 in a single 24 hour period breaking the world record for the most RCC placed in a single 24 hr period for any RCC dam structure worldwide to date.

The previous record was held at the Longtan RCC dam in China and previously again at the Saluda dam in the US with 18,475m3 and 14,135m3 placed in a single 24 hr period respectively. The industry world record achieved at Longtan held for nearly 10 years but it should be noted that the scheme there had two conveyor placement systems, a larger batching plant facility as well as two contractors working independently and simultaneously. Regardless, the achievements at Longtan should not be discounted in the very difficult nature of dam construction.

As there have been over approximately 650 RCC dams completed to date, many of which are over 100m tall and containing as much as 6Mm3, industry experts agreed that the record achievement at Longtan seemed unchallenged and out of the reach of any realm of ingenuity in RCC dam construction.

That all changed during the morning hours of December 12, 2014 after the totals for the previous day were tallied.

At Gibe III the world record was achieved by using a single belt conveyor system, a well-synchronized RCC plant and a single contractor. The RCC aggregate production, batching and conveying system(s) to the dam was a combination of the highest quality plants consisting of Sandvik crushing equipment, Sicoma mixers (Italy) and a very sophisticated RCC conveyor system capable of handling in excess of 850m3/hour by RCC Conveyors USA LLC.

The RCC placement team at Gibe III

The Gibe III dam, although not entirely completed, is currently the tallest, largest standing RCC dam in the world.

This is truly a remarkable achievement and a tribute to brilliant ingenuity and the hard work of all involved. It should be noted that with an RCC placement operation one of the main advantages is the amount of RCC that can be placed continuously as this always will render good quality construction as well as many other advantages.

It should be noted that the entire operation while very sophisticated, was well planned out, and well managed by the contractor and the results are a true testimony to this achievement and ultimate success of the project. Considering that the dam is located in a remote area, with long supply lines for anything imported, finding cement and even providing fuel (3 million liters per month), this project was also a major logistical challenge. It should be noted that with proper planning and procuring the right equipment, people and resources for any project of this nature are the key to success.

The project is a tribute to the hard work and dedication of the Salini-Impregilo team, leading to one of the greatest achievements in Roller Compacted Concrete dam construction since its inception some four decades ago.

Grand Ethiopian Renaissance Dam, Ethiopia

This 6000MW project - previously named the Millenium scheme - is being built on the River Abbay (the Blue Nile) and will feature one of Africa's largest dams, a 1.8km long, 170m high RCC structure. The project will feature 16 x 375MW turbines, and is being built by the same team behind the Gibe III project, led by Salini-Impregilo S.P.A.

The project is being built in a remote location, although the site topography is far different to that of Gibe III - in particular the terrain is friendlier with a long valley area and gentler abutments.

The project's dam contains some 10Mm3 RCC and includes a 70m rockfill saddle dam. There will be two surface Powerhouses located immediately downstream of the dam at the right and left abutments accordingly, housing the 16 Francis turbines.

Preparatory works for construction started in December 2010. The RCC production for the dam began in late 2013 and by December 2014, some 1.9Mm3 had been placed in the main dam. The corresponding average monthly rate of placement is 142,177. The maximum daily rate is 16,949 which is slightly lower that that achieved at the Gibe III project.

In October, developers Ethiopia Electric Power announced that the scheme as a whole was 40% complete.

When finished, the project will supply much-needed power to Ethiopia and its neighboring countries in the region and contribute to overall development in the region.

Xiluodu project, China

The Xiluodu Hydroelectric project in China is the second largest hydropower plant in China and the third in the world with an installed capacity of 13,860MW.

The dam and hydro complex is located upstream of the world famous China Three Gorges dam on the Yangtze River. China Three Gorges Project is the largest hydropower installation in the world with an installed capacity of 22,500MW followed by Itaipu Hydropower project in Paraguay/ Brazil with an installed capacity of 14,000MW.

The project features a 285.5m high double curvature arched concrete dam consuming 6.2Mm3 low slump CVC (conventional, Vibrated Concrete). It includes two underground power complexes each containing 9 X 770 generating units for a total installed capacity of 13,860MW, two power intake, and a network of complex headrace and tailrace tunnels.

Upstream face at Xiluodu

Preparatory works for the project started at the end of 2003 but was temporarily stopped in 2005 to allow for completion of the Environmental Impact Statement. Its official initiation was at the end of 2005. The River diversion was completed in 2007. The concreting operation for the dam started in the last quarter of 2008 and the dam was substantially completed in 2013. The commissioning of the last unit was in July 2014.

The design and construction planning for this colossal structure was well planned out and executed. The arched structure was built with interlocking concrete monolith blocks with nearly "0" slump (10-15 mm) mass concrete and the blocks were constructed simultaneously as the dam rose out of the difficult valley foundation to its ultimate height of 285.5m. There was a network of cooling pipes placed within the mass of the dam for the mass CVC that continued throughout construction and will continue to cool the concrete as it cures.

The project had nearly vertical abutments and the terrain was similar to that of the Hoover dam in the US making delivery of the concrete to respective placements very difficult.

The contractor set up five overhead cable cranes and blonden systems that spanned the valley high above the respective abutments to deliver the concrete the respective monolith placements. Three concrete batching plants were in place that were dedicated to the concrete production for the dam at the upper right abutment. Each concrete plant has a capacity of some 500m3/ hr. The concrete placements took place 24 hrs a day 7 days a week for just over four years. The concrete was mixed and dumped into 9m3 capacity side dump trucks that delivered the concrete to a loading key at the nearby upper Right Abutment.

From there the concrete was dumped into very large 9m3 capacity buckets hooked to one of the cable cranes and cast across the valley to the respective placement(s). As many as three monolith placements were being constructed simultaneously as the concrete structure grew larger and taller. The concrete within the respective placements was spread across the placement area using small bulldozers and then compacted with large 150mm gang vibrators mounted on small specially equipped excavators. Hand immersion vibration vibrators were also used in confined areas where the larger gang vibrators could not compact the concrete.

Approximately 9m^3 of concrete was delivered into the dam body continuously every 60-90 seconds 24 hrs a day.

It generally took between 5-7 minutes to deliver the freshly mixed concrete to its final placement in the dam using the side dumpers and cable crane Blonden systems, ensuring quality and fresh concrete was always delivered to the dam.

Each concrete plant had a testing laboratory to ensure that all of the specifications were being met for the various concrete mixes used in the dam.

The success of this project was due to a well thought out design, procurement and construction implementation program and it is now is on line to supplement the national Electric Grid of China with clean sustainable energy.

Ted Warren is a construction Civil Engineer from the US who has assisted in more than 30 RCC dams and hdroelectric projects in more than 20 countries worldwide. He has worked on some of the largest hydroelectric projects currently under construction and maintains records of RCC production and hydropower development achievements through the projects he has worked on over the past 25 years.

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Thanks are given to Gabriel Escobar, Gibe III - Dam Superintendent, for photographs of Gibe III placement operations and the cover photograph.

Also thanks to Linaldo Forcellini, Gibe III - Production Manager and co author; Eugino Zopis, Project Manager and co-author; Bruno Ferraro, equipment procurement and project implementation, and to EEPCo and all staff dedicated to the project.

(Water Power, 11 February 2015, http://www.waterpowermagazine.com/features/featureworld-class-achievements-as-dams-reach-new-heights-4509863)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

ISSMGE's International Journal of Geoengineering Case Histories

The International Journal of Geoengineering Case Histories proudly announces that its request to be indexed in Georef has been approved!

All its articles are now part of the Georef database. Georef is the leading geosciences database in North America, established by the American Geosciences Institute (AGI) in 1966. The database was created with the mission to provide access to the most comprehensive geosciences literature worldwide, containing nowadays millions of references to geosciences maps, serial and non-serial literature. Coverage for North American resources starts in 1669, whereas worldwide coverage starts in 1933. From now on, the International Journal of Geoengineering Case Histories and all its past and future papers are going to be part of this database.

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Στην ηλεκτρονική διεύθυνση https://www.ita-aites.org/en/publications/search-for-a-publication προσφέρονται όλες οι εκδόσεις της ΙΤΑ από το 1978 μέχρι το 2015.

GeoWorld offers Free Access to Geotechnical News Magazine for Student Members!

GeoWorld is glad to announce that from now on, the well-known Geotechnical News (GN) Magazine will be accessible through GeoWorld.

The magazine is published every quarter and includes a lot of valuable technical content. Through this partnership, students who are registered on GeoWorld, will have direct access to the entire content of the magazine at no cost! Non-student GeoWorld members will be able to view the table of contents, but will have to register through Bitech Publisher's website to view the content. The Geotechnical News Magazine is a leading resource magazine for geotechnical information, that keeps the professional geotechnical community up-to-date for 20 years.

Read in the March issue the main topic titled 'A closed tailings storage facility at the El Indio Mine in Chile.'. Make sure that you update your Profile Settings in 'Industry' Field as 'Student' and also include your University name in the field 'Current Company / Organization Name', and view March Issue now!

The proposal submission for the 2016 research plan is now open! The DEADLINE is July, 15, 2015

If you do have an innovative research project in the Geotechnical and/or Civil Infrastructure disciplines and need support with you, kindly send us all details about your project by replying this email in no more than 2 pages, and we will study our interest in your project and the ability of cooperation. Please request a "Read Receipt" in your email to receive an acknowledgement when we read it.

We will send a notification e-mail for all projects during September, 2015 concerning our ability to cooperate or not.

The way of cooperation will be discussed with the *PIs* of the selected projects.

Please visit our website to browse the research topics of SSIGE; www.ssige.org

We are pleased to notify you that, we are now cooperating with many Middle-East universities and research groups, in addition to some reputable worldwide organizations. So, all the research needs of funding, tools, resources and international expertise will be provided.

We are waiting your e-mail concerning your project!

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΜΗΧΑΝΙΚΩΝ

Ο ομότιμος καθηγητής **Παύλος Γ. Μαρίνος** ήταν ο κεντρικός προσκεκλημένος ομιλητής (keynote) στο Συνέδριο της Ουγγρικής Εταιρίας Τεχνικής Γεωλογίας και Βραχομηχανικής του 2015, όπου εορτάσθηκαν και τα 150 χρόνια του Τομέα των Γεωεπιστημών στο Πολυτεχνείο της Βουδαπέστης. Το θέμα ήταν "Geological uncertainties and decisions in the design and construction of engineering works".

Ο Παύλος Μαρίνος προσεκλήθη επίσης ως κεντρικός ομιλητής στον εορτασμό των 100 ετών του Department of Geological Engineering του Πανεπιστημίου της Κωνσταντινούπολης που θα πραγματοποιηθεί τον Μάιο του 2015.

ΥΠΟΤΡΟΦΙΕΣ ΓΙΑ ΓΕΩΜΗΧΑΝΙΚΟΥΣ

The Matsumae International Foundation

Το Ίδρυμα Matsumae International Foundation στο Τόκυο, προσκαλεί Έλληνες επιστήμονες για συμμετοχή στο πρόγραμμα υποτροφιών "Fellowship Program του Matsumae International Foundation", την περίοδο Απριλίου 2016 - Μαρτίου 2017. Άμεση προτεραιότητα δίδεται στις Φυσικές Επιστήμες, τη Μηχανική και την Ιατρική. Για το ανωτέρω χρονικό διάστημα θα χορηγηθούν υποτροφίες για Εταίρους (Fellows) από όλες τις χώρες του κόσμου. Η διάρκεια έρευνας κυμαίνεται από τρεις (3) έως έξι (6) μήνες, από τον Απρίλιο του 2016 έως τον Μάρτιο του 2017. Οι αιτούντες επιλέγουν Ερευνητικά Εργαστήρια σε Πανεπιστήμια, Εθνικά Ερευνητικά Ινστιτούτα ή σε αντίστοιχα του ιδιωτικού τομέα, στα οποία προτίθενται να διεξάγουν έρευνα. Πριν να υποβάλλουν την αίτησή τους, οι ενδιαφερόμενοι οφείλουν να έχουν γίνει επισήμως δεκτοί από τα Ιδρύματα στα οποία ενδιαφέρονται να εκπονήσουν ερευνητικό πρόγραμμα. Περισσότερες πληροφορίες: http://www.mars.dti.ne.jp/mif.

Fellowship Announcement

Upon the concept of the founder of the Matsumae International Foundation (MIF), "Towards A Greater Understanding of Japan and a Lasting World Peace", MIF has started the Research Fellowship Program in 1980.

Currently, MIF is receiving application for Research Fellowship Program until the 31st of August 2015. For details, please see the "Research Fellowship Program 2016 Announcement."

Eligibility Requirements:

Applicants of non-Japanese nationality; a Doctorate degree; must be under 49 years old; not have been in Japan previously; have firm positions and professions in their home nations; etc.

Host Institution In Japan:

Applicants are free to select host institutions (university research laboratories, national research institutions or the corresponding facilities of private industry)

Fellowship Details:

Stipend for research and stay, Insurance, Air transportation (a round-trip air ticket to/from Tokyo) and Lump sum on arrival

Period & Number of Fellowships:

For a period of from three to six months; the number of fellowships is about 20 persons each year.

http://www.mif-japan.org/fellowship/announcement/?hl=en

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

The First Kazakhstan – USA Geotechnical Engineering Workshop, Astana and Almaty, Kazakhstan, 13-16 July 2015, geostroi@mail.ru

ICGE 2015 International Conference in Geotechnical Engineering – Colombo-2015, 10 - 11 August 2015, Colombo, Colombo, Sri Lanka, http://www.slgs.lk/?p=564

Numerical Analysis in Geotechnics, 20 August 2015, Hanoi, Vietnam, nag2015secretariat@gmail.com

China Shale Gas 2015 - an ISRM Specialized Conference, 6-8 September 2015, Wuhan, China, http://english.whrsm.cas.cn/ic/ic/201405/t20140509_120692.html

"Underground Construction" Conference, 8-9 September 2015, Krakow, Poland, www.inzynieria.com

13th International Benchmark on the Numerical Analysis of Dams, 9 - 11 September 2015, Lausanne | Switzerland http://icold2015bmw.epfl.ch

International Symposium on Geohazards and Geomechanics 10-11 September, 2015, Coventry, U.K., www.warwick.ac.uk/isgg2015

24th European Young Geotechnical Engineers Conference in Durham, UK, 11-12 September, 2015, https://www.dur.ac.uk/conference.booking/details/?id=419

16th European Conference on Soil Mechanics and Geotechnical Engineering "Geotechnical Engineering for Infrastructure and Development", 13 - 17 September 2015, Edinburgh, UK, www.xvi-ecsmge-2015.org.uk

Workshop on Volcanic Rocks & Soils, 24 - 25 September 2015, Isle of Ischia, Italy, www.associazionegeotecnica.it

The 7th International Symposium on Roller Compacted Concrete (RCC) Dams, Chengdu, China, Sept. 24th -25th, 2015, www.chincold.org.cn

Athens 2015 International Landfill Mining Conference, September 24-25, 2015, Athens, http://www.erasmus.gr/microsites/1050/welcome-address

TranSoilCold 2015 - The 2nd International Symposium on Transportation Soil Engineering in Cold Regions, September 24-26, 2015, Novosibirsk, Russia, http://transoilcold2015.stu.ru/index.htm

GE Basements and Underground Structures Conference 2015, 6 - 7 October 2015, London, UK, http://basements.geplus.co.uk

EUROCK 15 ISRM European Regional Symposium & 64th Geomechanics Colloquy, 7 – 9 October 2015, Salzburg, Austria, www.eurock2015.com

Shotcrete for Underground Support XII New Developments in Rock Engineering, TBM tunnelling, Deep Excavation and Underground Space Technology, October 11-13, 2015, Singapore, www.engconf.org/conferences/civil-and-environmental-engineering/shot-crete-for-underground-support-xii

5th International Symposium on Geotechnical Safety and Risk (ISGSR 2015), 13-16 October 2015, Rotterdam, The Netherlands www.isgsr2015.org

☙ ❧

International Workshop on Tsunamis in the World: from Source Understanding to Risk Mitigation
14 to 16 October, 2015, Heraklion, Greece
www.gein.noa.gr/itw2015

The **International Workshop on Tsunamis in the World: from Source Understanding to Risk Mitigation** will be held from 14 to 16 October, 2015, in Heraklion, capital city of Crete Isl., Greece, with the participation of experts, young scientists and representatives of international organizations from around the globe. The programme includes oral and poster presentations, discussions and social events to be held from 14 to 15 October. A half-day (morning) field trip of tsunami interest is scheduled to take place on 16th October. The Workshop will take place back-to-back with the **2nd Annual Meeting of the EU-FP7 tsunami research project ASTARTE**. The ASTARTE Annual Meeting will be held during the afternoon of 16th October and the full day of 17th October 2015.

Workshop thematic areas

1. Mechanisms of tsunami generation.
2. Understanding the generation of mega earthquakes and tsunamis with emphasis in subduction zones.
3. Numerical simulations.
4. Laboratory experiments.
5. Historical case studies (Cascadia, Japan, Kamchatka, Indonesia, Mediterranean Sea, South America etc.).
6. Seismic, volcanic, landslide and other types of tsunamis, including meteotsunamis.
7. Lessons learned from recent cases of mega earthquakes and tsunamis (e.g. Sumatra 2004, Chile 2010 and 2014, Tohoku 2011).
8. Geological signatures of tsunamis onshore and offshore.
9. Tsunamis in the European-Mediterranean region.
10. Tsunami hazard, vulnerability and risk assessment methodologies and case studies.
11. Early warning systems: regional, national, local (near-field).
12. Pre- and post-disaster planning for risk mitigation and recovery.
13. Education, training, awareness, preparation.

For further inquiries please contact
itw2015@noa.gr

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HYDRO 2015, 26-28 October 2015, Bordeaux, France, www.hydropower-dams.com/pdfs/hydro2015.pdf

International Conference on Engineering Geology in New Millennium, 26-31 October 2015, New Delhi, India, http://isegindia.org/pdfs/1st%20circular-international-IAEG.pdf

6th International Conference on Earthquake Geotechnical Engineering, 2-4 November 2015, Christchurch, New Zealand, www.6icege.com

SEOUL 2015 - 25th World Road Congress Roads and Mobility – Creating New Value from Transport, 2–6 November, 2015, Seoul, Republic of Korea, http://www.aipcrseoul2015.org

4° Πανελλήνιο Συνέδριο Ααναστηλώσεων, Νοέμβριος 2015, Θεσσαλονίκη, www.etepam.gr.

The 15th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, 9-13 November 2015, Fukuoka, Japan, http://www.15arc.org

15th Pan-American Conference on Soil Mechanics and Geotechnical Engineering, 15 - 18 November 2015, Buenos Aires, Argentina, http://conferencesba2015.com.ar

GEOMATE, 16 -18 November 2015, Osaka, Japan, www.geomate.org

VIII South American Congress on Rocks Mechanics, 15 - 18 November 2015, Buenos Aires, Argentina, http://conferencesba2015.com.ar

Sixth International Conference on Deformation Characteristics of Geomaterials IS Buenos Aires 2015, November 15th to 18th 2015, www.saig.org.ar/ISDCG2015

ARABIAN TUNNELLING CONFERENCE & EXHIBITION

Innovative Underground Infrastructure - And Opportunities

23-25 November 2015, Dubai, UAE

www.atcita.com

We are cordially inviting you to join us in the third edition of Arabian Tunnelling Conference (ATC 2015) which will be held on 23-25 November 2015 in Dubai, United Arab Emirates. This year's theme is "Innovative Underground Infrastructure – Challenges and Opportunities". ATC 2015 is the premier networking hub of the experts and professionals in Tunnelling and Underground Space industry. The key activities of this event are Conference, Exhibition, Sites Visits, Young Engineers Forum and Awards.

ATC 2015 will embody the engineering and tunneling sector at the global level. It will serve as a gathering of key and influential participants who will network with hundreds of the regional engineering professionals, tunnelling experts and global audience of their peers. The conference will address the challenges and explore the opportunities associated with innovative tunnelling and Underground Space Infrastructure. The event will connect the international experts and partners in the industry to create innovative sustainable solutions and business opportunities.

Society of Engineers – UAE and in partnership with International Tunnelling and Underground Space Association (ITA) will directly manage and organize the ATC 2015. Our technical program will present leading-edge technology, updates, significant developments and best practices solutions that support the innovation in tunnelling and underground space use for infrastructure, transportation, telecommunication, energy, water storage, facilities and waste management.

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Geo-Environment and Construction, 26-28 November 2015, Tirana, Albania, Prof. Dr. Luljeta Bozo, lulibozo@gmail.com; luljeta_bozo@universitetipolis.edu.al

ICSGE 2015
International Conference on Soft Ground Engineering
3–4 December 2015 | Singapore

www.geoss.sg/icsge2015

The International Conference on Soft Ground Engineering (ICSGE2015) is jointly organized by the Geotechnical Society of Singapore (GeoSS), the Centre for Soft Ground Engineering (CSGE) at National University of Singapore (NUS), and the Building and Construction Authority (BCA). The ICSGE2015 offers a platform for engineers and researchers to interact and share experience on geotech-nical design and construction issues in soft ground.

The ICSGE2015 is pleased to invite original, previously-unpublished and high-quality research papers related but not limited to the following conference themes:

- Excavation and retaining structures in soft ground
- Foundations and structures on soft ground
- Ground improvements in soft soils
- Laboratory and numerical studies on soft soils
- Case studies on soft ground engineering problems

Abstracts from other themes relevant to conference are also welcome.

Technical Queries
E-mail: icsge2015@geoss.sg

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The 1st International Conference on Geo-Energy and Geo-Environment (GeGe2015) 4th and 5th December 2015, Hong Kong, http://gege2015.ust.hk

2015 6th International Conference Recent Advances in Geotechnical Engineering and Soil Dynamics, December 7-11, 2015, New Delhi (NCR), India, wason2009@gmail.com; wasonfeq@iitr.ernet.in, sharmamukat@gmail.com; mukutfeq@iitr.ernet.in, gvramanaiitdelhi@gmail.com, ajaycbri@gmail.com

Southern African Rock Engineering Symposium an ISRM Regional Symposium, 5 January 2016, Cape Town, South Africa, http://10times.com/southern-african-rock

Sixth International Conference on
Water Resources and Hydropower Development in Asia
1-3 March 2016, Vientiane, Lao PDR
www.hydropower-dams.com/pdfs/asia20161.pdf

In terms of water resources and hydropower development, Asia is unique. The region hosts some of the largest dams and powerplants in the world, for example in China, India, Russia, Malaysia and Pakistan, as well as many thousands of small-scale hydro and irrigation schemes in rural areas.

The vast remaining potential of Asia offers enormous opportunities to develop clean renewable energy, while using the associated water storage to bring a number of other benefits for communities. There are major business opportunities for all involved in advancing sustainable hydropower and multipurpose water infrastructure in Asia.

For the less developed countries in the region, hydro potential is equivalent to a gold mine: power trading is helping to meet the rapidly increasing demand for electricity in neighbouring countries, while boosting national economies, and supplying local requirements.

But it is well known that Asian water infrastructure faces some of the toughest challenges, for example: extreme floods, large magnitude earthquakes, challenging site conditions, and sedimentation issues.

Against this background, Aqua~Media launched its series of biennial international conferences for Asia in 2006, bringing together experts from all parts of the world, to focus on issues specific to the plans, activities, achievements and challenges of Asia. Events have taken place in Bangkok, Danang, Kuching, Chiang Mai and Colombo. Technical, financial, economic, social and environmental issues are discussed in sessions, panels and workshops.

ASIA 2016 Themes for discussion in sessions, panels and workshops

Development potential and planning

- Regional overview and masterplans
- Potential, planning and new developments; regional insights
- Trans-boundary and cascade scheme planning
- New planning tools
- Flood early warning systems and mitigation measures

Financial, legal and contractual aspects

- New approaches to project finance
- Selection and screening of projects for private development
- Commercial and financial risk management
- PPAs for transboundary power trading
- Concession agreements (balancing the interests of the parties)
- Procurement of concessionaires
- Contractual aspects of private hydro development
- Construction arrangements (alternative procurement models)

Environmental and social aspects

- Design adaptations and adaptive resource management for climate change
- Cumulative impact assessment and cross border cooperation
- Rapid Sustainability Assessment Tool: examples from the Mekong region
- Asset conservation including sedimentation management
- Problems with biological growth in hydro plants
- Fish protection and management of reservoirs and waterways
- Biomass clearance and biodiversity offset creation
- Preserving and promoting cultural heritage assets
- ESIA and IFI safeguard workshop
- Hydrology and environmental flow assessment; downstream management
- Capacity building and transfer to the next generation; a participatory approach

Hydropower and sustainable development

- Maximizing and communicating the multiple benefits of hydro
- The food-water-energy nexus approach • Synergy among the renewables
- Making hydro more competitive (managing and mitigating risk)
- Regional development through power trading

Hydropower technology

- Innovations in hydraulic machinery: research and development
- Use of hydro and pumped storage in the regulation of electrical systems

• Recent developments in electrical systems
• Operational and maintenance issues
• Powerplant safety
• Pumped-storage technology; applications in Asia
• Small and low-head hydro
• Engineering quality in a competitive hydro market
• Marine energy potential

Civil engineering

• Materials for dams and appurtenant works
• Advances in design and construction techniques
• Recent developments in dam construction
• Innovative approaches to evaluating safety
• Monitoring and engineering for safe structures and sites
• Underground works and tunnelling
• Uprating and refurbishment of existing infrastructure
• Spillways and gates: design, function and innovation
• Small dams
• Low cost irrigation and storage solutions

ASIA2016,
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GeoAmericas 2016 3rd Panamerican Conference on Geosynthetics, 11 – 14 April 2016, Miami Beach, USA, www.geoamericas2016.org

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

SIMSG ISSMGE

ETC3 – Piles

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

Almost 20 years ago, ETC3 organised an international seminar dedicated to European practice for the design of axially loaded piles. Since that time, Eurocode 7 has been published and in many countries the approach to the design of geotechnical works has been adapted. For pile design, Eurocode 7 gives a framework where design methods should fit in, but does not provide any precise rules. Many European countries carried out a lot of research work, including field and model tests as well as pile-soil models in order to adapt their national rules. In many cases the results of that scientific work have been integrated in new regulations described in the National Annexes, codes or recommendations. A real need exists to exchange information on how pile design has evolved in the different European countries. This includes axially or laterally loaded, individual piles or pile groups.

The first objective of the symposium is to give the European geotechnical engineers the opportunity to familiarise themselves with those various national design methods. It will also give comprehensive comparison material for better understanding and further research works. Each country represented in the ETC3 committee is invited to elaborate a detailed report concerning their national design methods. These national reports will be published in the proceedings.

During the symposium, a thematic analysis of the National Reports will be presented, enabling a better comparison. Attention will also be paid to the evolution of the standardisation with regard to the execution of piles. Special attention will be paid to the requirements regarding concrete for deep foundations (CEN/TC 288, CEN/TC 104, EFFC-DFI Activities) and will be discussed.

In addition to that, keynote lectures and special contributions will address the evolution of pile design according to Eurocode 7 (CEN/TC 250/SC 7), the standardisation on pile testing in Europe (CEN/TC 341/ISO TC 182) and the practical application of static, dynamic and rapid load testing in pile design. Additional topics such as quality control, monitoring and new measuring techniques will be covered. Many outstanding speakers have already confirmed their participation (C. Gilbert, A. Bond,...)

It is the strong hope of the ETC3 committee that knowledge and understanding of the various national design methods will help geotechnical engineers to interpret the results obtained, enlarge their view on pile behaviour and encourage, to some extent, a convergence of the European design rules.

The active participation of the chairmen of the relevant standardisation committees dealing with design , execution and testing of piles will certainly contribute to this objective.

Download First bulletin and pre-registration form : ETC3 Symposium 2016 First bulletin
Download Template National reports : ETC3 Symposium 2016 Template National Reports
Download Sponsoring options : ETC3 Symposium 2016 Sponsoring Options

SYMPOSIUM SECRETARIAT

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

84th ICOLD Annual Meeting, 16-20 May 2016, Johannesburg, South Africa, www.sancold.org.za/index.php/activities/icold-annual-meeting-2016

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

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

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

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

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

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ISC'5
5–9 SEPT 2016
Jupiters Hotel, Gold Coast
Queensland AUSTRALIA
WWW.ISC5.COM.AU
5TH INTERNATIONAL CONFERENCE ON GEOTECHNICAL AND GEOPHYSICAL SITE CHARACTERISATION
IN PURSUIT OF BEST PRACTICE

Gold Coast, Queensland, Australia
http://www.isc5.com.au

Site characterisation is unarguably the most important, but also most "difficult", component of geo-engineering. ISC'5 brings together the world's experts who, with you and others, are working daily to improve the quality and reduce the difficulties involved. This conference is the forum for sharing this knowledge and experience. Hear and contribute to the latest ideas and technologies at the conference. See and touch and learn of the latest hardware and software and services at the trade exhibition. Take home new knowledge and give some to others to take also home.

Conference Themes

Penetration testing: *In situ* characterisation using various forms of cone tests, dilatometer tests, full-flow penetrometers, dynamic penetrometers (e.g. SPT) and free fall devices

Geophysics: Characterisation and interpretation of the full suite of geophysical tests. Comparisons with in situ and laboratory test data.

Environmental testing: Characterisation of contaminated sites and landfills, applications to remediation

***In situ* testing of rock:** Developments in *in situ* rock testing that enable assessment of characteristics such as permeability, stiffness, strength and structure

Pressuremeter: Site and soil characterisation using various pressuremeter devices

Characterisation of non-standard soils and unsaturated soils: Interpretation of characterisation tests in partially saturated soils and in non-standard materials such as tailings and crushable soils

Interpretation of *in situ* tests: New developments extending current theory or refining existing theory

Liquefaction assessments: Using *in situ* and laboratory based techniques to assess liquefaction potential of soils and, in particular, soils for which there are limited data

Developments in technology and standards: New and improved site and laboratory based techniques for site characterisation, developments in national and international standards

Sampling: Developments in onshore and offshore sampling techniques, Quantification of effects of various sampling techniques in different soils, developments to reduce effects of sampling disturbance.

Design using in-situ tests: Direct application of *in situ* test parameters to the assessment of the performance of foundations and other geotechnical structures.

Application of statistical techniques to site characterisation: Improved site and ground characterisation using statistics and stochastic analysis

Pavements and fills: Characterisation of pavements and fills, correlations with various characterisation tools

Case Histories: Documentation of previous experience and lessons for practice, relationships between *in situ* and laboratory test data and with the performance of geotechnical structures

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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

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

ARMS 9, 9th Asian Rock Mechanics Symposium, ISRM Regional Symposium, October 2016, Bali, Indonesia, rkw@mining.itb.ac.id

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

Recent Advances in Rock Engineering - RARE 2016 - an ISRM Specialised Conference
16-18 November 2016, Bangalore, India

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

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

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

On behalf of the Local Organizing Committee for the 19th International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE 2017), I am pleased to welcome you all to the ICSMGE 2017 to be held in Seoul, Republic of Korea, from October 17 to 22, 2017.

The theme of the ICSMGE 2017 is "Unearth the Future, Connect Beyond [ ]." It is about bridging the gaps between past and future, between young and senior engineers, and between developing and developed nations among others. Making these connections is the key to greater innovations. The logo for the ICSMGE 2017 symbolizes our vision where the colours represent how well and harmoniously living organisms, groundwater and strata coexist- the way we hope different regions can coexist in harmony- while the waves represent the Han River, which is the heart of Korea's economic growth.

The ICSMGE 2017 will prepare various programs, including a Plenary Session, Parallel Sessions, ISSMGE Honour Lectures, iYGEC, Technical visits, and exhibitions. The Local Organizing Committee would like to invite you all and share our experiences with member societies. We are ready to reach out and listen to various and valuable voices from member societies and are willing to reflect their wishes into the program, serving as a rainbow bridge between member societies in ISSMGE and beyond.

Topics

Topic 1: Laboratory Testing and Modelling

1a: Laboratory Testing
1b: Numerical/Physical Modelling
1c: Prediction of Soil Behaviour
1d: Unsaturated Soils
1e: Problematic Soils and Geosynthetic Material
1f: Micro-macro Transition

Topic 2: Small and Large Works

2a: In-situ Testing
2b: Foundations and Retaining Structures
2c: Tunnelling
2d: Railways
2e: Roads and Pavements
2f: Marine and Fluvial Geotechnics
2g: Underground Structures
2h: Structures in Seismic Areas
2i: Pile Foundations
2j: Ground Improvement, Grouting and Dredging

Topic 3: Natural Hazards

3a: Slope Stability and Landslides
3b: Earthquake Related Problems
3c: Coastal and Fluvial Hazards
3d: Floods

3e: Drought
3f: Other Natural Hazards

Topic 4: Environmental Preservation and Sustainable Development

4a: Preservation of Historic Sites
4b: Protection and Rehabilitation of Ecosystems
4c: Assessment and Treatment of Pollution
4d: Reversible Construction
4e: Geotechnics and Renewable Energies
4f: Optimizing Construction and Sustainable Development

Topic 5: Geotechnical Cultures and Responsibilities

5a: National and International Practices
5b: Standards and Design Codes
5c: Regulations and Innovation
5d: Geotechnical Education and Training
5e: Instrumentation in Geotechnical Engineering
5f: Monitoring and Observational Design
5g: Risks and Responsibilities of Geotechnical Engineers

ICSMGE 2017 Secretariat
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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

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

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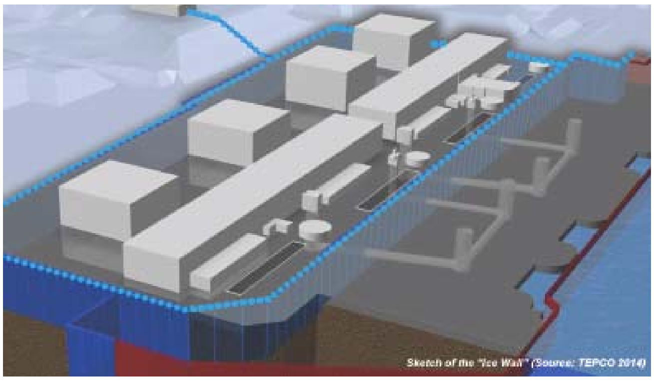
ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Engineering Services for Fukushima Nuclear Power Plant

Kajima Corporation of Tokyo, Japan, has contracted with Geocomp of Acton, MA, to provide engineering services on the construction and evaluation of an "Ice Wall" groundwater barrier around the Fukushima Nuclear Power Plant. Geocomp has subcontracted with Moretrench American Corporation, North America's largest ground freezing contractor, to assist with their construction experience.


Sketch of the "Ice Wall" (Source: TEPCO 2014)

Geocomp and Moretrench will provide Kajima with assessments of comparable ground freezing experiences from around the world to help share technological achievements to enhance the design, construction, and performance of the Fukushima Ice Wall. They will assist in the evaluation of the plans for design, construction quality assurance, and performance testing. This team brings experience from some of the largest and most challenging ground freezing projects performed in North America.

Artificial ground freezing is the process of converting the subsurface pore water to ice to produce a strong, watertight barrier. It has been used for over one hundred years in the construction of deep shafts, excavations and groundwater barriers in the mining and civil construction industries.

Geocomp is providing coupled groundwater, heat flow analyses to evaluate potential failure modes for the "Ice Wall". Asked about the project, Dr. Marr replied, *"We feel very honored to be asked to participate in this unprecedented project and to have the collaboration of Moretrench's experienced staff."*

An unusal aspect of the project is that the project report must be provided in both English and Japanese. Sayonara.

For further information, please contact Dr. Allen Marr, P.E., Founder and CEO, wam@geocomp.com.

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The chronicle of a slow moving landslide; Val Parghera Switzerland

Contrary to the common belief that landslides are violent, quickly evolving natural phenomena, triggered by heavy rain, earthquakes or volcanic activity, today's time lapse proves that landslides may move much slower. The time lapse presents the evolution of a landslide in Switzerland over a time span of 20 months as monitored by a Swiss consulting firm.

The Val Parghera landslide, at Switzerland's largest canton; Grisons is a slowly evolving phenomenon occurring next to important infrastructure such as railways and highways. To monitor the landslide, GEOPRAEVENT consults, hired by the canton's authorities, installed webcams, radars and laser scans in the area. Engineers measured different landslide velocities ranging from 3.9inches per hour (recorded in June 2013) to as low as 0.4inches per month.

Watch the video, compiled from pictures taken from May 2013 to January 2015! https://www.youtube.com/watch?v=5-nyAz484WA

(Geo-Engineer Newsletter No 120, February 2015, www.geoengineers.org).

From the company's website:

Val Parghera landslide monitoring

In April 2013, snow melt and precipitation activated extensive terrain movements in the Parghera valley in the vicinity of Domat-Ems, in the Canton of Grisons. On April 19 authorities were forced to close the cantonal road and establish an emergency bridge across the torrent. The close proximity to the tracks of the Rhaetian Railway as well as the A13 highway increased the need to take action. Within a month Geopraevent installed several gauge radars and webcams in order to monitor the landslide, registering multiple mud- and debris-flow surges. Additionally, a weather station provides current and local data on temperature and precipitation. In order to assess the amount of debris still prone to slide, interferometric radar measurements were carried out in June 2013 and several more webcams were installed in the course of the summer months. In the hastily enlarged sediment trap, material was constantly accumulating. The sediment needs to be liquefied in order to be washed downstream or deposited in the surrounding area. The extensive surveillance systems allows authorities to carry out these tasks as efficiently as possible, while always being up to date on registered movements and ensuring the safety of the traffic routes. Different positions along the torrent, close to the roads and sediment traps can be watched day and night from any computer or smart phone. Whenever critical stage thresholds are surpassed, warnings are automatically issued by SMS (Swisscom eAlarm).

Mudflow captured by one of the webcams on August 19th, 2014 https://www.youtube.com/watch?v=DEKe3FgJcHA

Monitoring of the sediment trap…
https://www.youtube.com/watch?v=dZfXukeROuk


… and the discharge channel.

Implemented technologies

- Gauge radars
- Webcams
- Interferometric radar
- Weather station

Alarm system

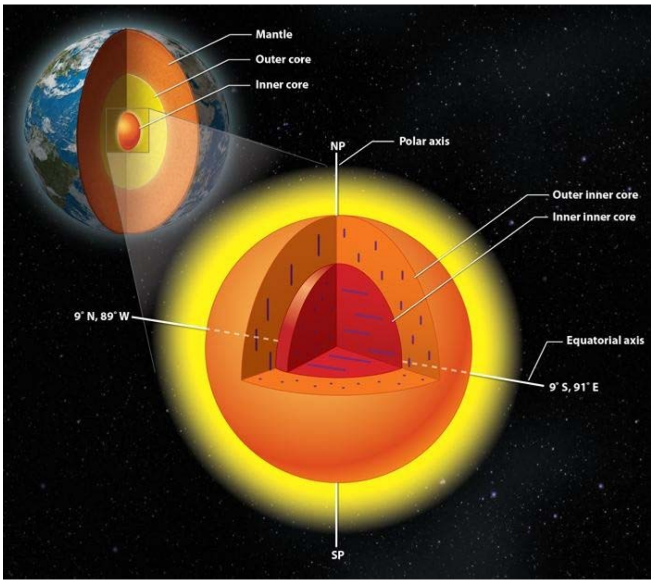
- Swisscom eAlarm

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Earth's surprise inside: Geologists unlock mysteries of the planet's inner core

Summary

Seismic waves are helping scientists to plumb the world's deepest mystery: the planet's inner core. Thanks to a novel application of earthquake-reading technology, researchers have found that the Earth's inner core has an inner core of its own, which has surprising properties that could reveal information about our planet.



A research team from the University of Illinois and colleagues in China found earth's inner core has an inner core of its own, with crystals aligned in a different direction.

Seismic waves are helping scientists to plumb the world's deepest mystery: the planet's inner core.

Thanks to a novel application of earthquake-reading technology, a research team at the University of Illinois and colleagues at Nanjing University in China have found that the Earth's inner core has an inner core of its own, which has surprising properties that could reveal information about our planet.

Led by Xiaodong Song, a professor of geology at the U. of I., and visiting postdoctoral researcher Tao Wang, the team published its work in the journal *Nature Geoscience* on Feb. 9.

"Even though the inner core is small -- smaller than the moon -- it has some really interesting features," said Song. "It may tell us about how our planet formed, its history, and other dynamic processes of the Earth. It shapes our understanding of what's going on deep inside the Earth."

Researchers use seismic waves from earthquakes to scan below the planet's surface, much like doctors use ultrasound to see inside patients. The team used a technology that gathers data not from the initial shock of an earthquake, but from the waves that resonate in the earthquake's aftermath. The earthquake is like a hammer striking a bell; much like a listener hears the clear tone that resonates after the bell strike, seismic sensors collect a coherent signal in the earthquake's coda.

"It turns out the coherent signal enhanced by the technology is clearer than the ring itself," said Song. "The basic idea of the method has been around for a while, and people have used it for other kinds of studies near the surface. But we are looking all the way through the center of the Earth."

Looking through the core revealed a surprise at the center of the planet -- though not of the type envisioned by novelist Jules Verne.

The inner core, once thought to be a solid ball of iron, has some complex structural properties. The team found a distinct inner-inner core, about half the diameter of the whole inner core. The iron crystals in the outer layer of the inner core are aligned directionally, north-south. However, in the inner-inner core, the iron crystals point roughly east-west.

Not only are the iron crystals in the inner-inner core aligned differently, they behave differently from their counterparts in the outer-inner core. This means that the inner-inner core could be made of a different type of crystal, or a different phase.

"The fact that we have two regions that are distinctly different may tell us something about how the inner core has been evolving," Song said. "For example, over the history of the Earth, the inner core might have had a very dramatic change in its deformation regime. It might hold the key to how the planet has evolved. We are right in the center -- literally, the center of the Earth."

Story Source:

The above story is based on materials provided by **University of Illinois at Urbana-Champaign**. *Note: Materials may be edited for content and length.*

Journal Reference:

1. Xiaodong Song et al. **Equatorial anisotropy in the inner part of Earth's inner core from autocorrelation of earthquake coda**. *Nature Geoscience*, Feb 9, 2015

Science Daily, February 9, 2015, http://www.sciencedaily.com/releases/2015/02/150209113222.htm

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

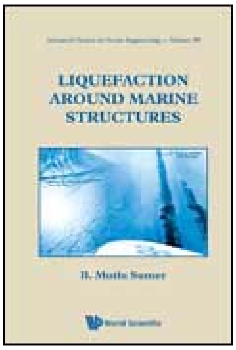
Nikola Tesla 3 6 9

"If you only knew the magnificence of the 3, 6 and 9, then you would have a key to the universe." - N.Tesla

Have you ever wondered why there are 360 degrees in a circle? This short video distills a lot of information about numbers, geometry and the relationship between them.

https://www.youtube.com/watch?v=inWnhZp_A-M
https://www.facebook.com/video.php?v=593521430803116

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



Liquefaction Around Marine Structures

Advanced Series on Ocean Engineering: Volume 39

B Mutlu Sumer

This book, whose primary aim is to describe liquefaction processes and their implications for marine structures such as pipelines, sea outfalls, quay walls and caisson breakwaters, discusses the subject of soil liqeufaction in the marine environment.

In addition, the physics of liquefaction (including examples illustrating the catastrophic consequences of soil liquefaction with regard to marine structures) are described, and the mathematical modelling of liqeufaction is treated in detail. Also, carefully selected numerical examples support the discussion of assessing liquefaction potential, and benchmark cases such as buried gas pipelines and their floatation, caisson breakwaters, cover stones and their interaction with liquefied soil along with counter measures are investigated.

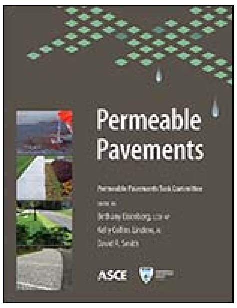
Contents:

- Introduction and Physics of Liquefaction
- Biot Equations and Their Solutions
- Residual Liquefaction
- Momentary Liquefaction
- Floatation of Buried Pipelines
- Sinking of Pipelines and Marine Objects
- Liquefaction Under Standing Waves
- Liquefaction at Gravity Structures
- Stability of Rock Berms in Liquefied Soil
- Impact of Seismic-Induced Liquefaction
- Counter Measures

(Sample Chapter: Chapter 1: Introduction and Physics of Liquefaction http://www.worldscientific.com/doi/suppl/10.1142/7986/suppl_file/7986_chap01.pdf)

Readership: Professionals and researchers in the area of coastal, ocean and marine civil engineering; graduate and post graduate students.

(World Scientific, May 2014)



Permeable Pavements Task Committee; edited by Bethany Eisenberg, LEED; Kelly Collins Lindow and David R. Smith

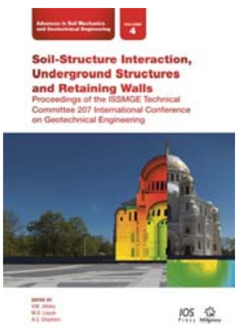
Sponsored by the Low Impact Development Committee of the Ur-ban Water Resources Research Council of the Environmental and Water Resources Institute of ASCE

Permeable Pavements is a comprehensive resource for the proper design, construction, and maintenance of permeable pavement systems that provide a transportation surface and a best management practice for stormwater and urban runoff. A cornerstone for low impact development (LID) and sustainable site design, permeable pavements are considered a green infrastructure practice. They offer many environmental benefits, from reduced stormwater runoff and improved water quality to better site design and enhanced safety of paved surfaces. Commonly used for walkways, driveways, patios, and low-volume roadways as well as recreational areas, parking lots, and plazas, permeable pavements are appropriate for many different land uses, particularly in highly urbanized locations.

This volume synthesizes todayâ€™s knowledge of the technology, drawing from academia, industry, and the engineering and science communities. It presents an overview of typical permeable pavement systems and reviews the design considerations. Detailed design, construction, use, and performance information is provided for porous asphalt, pervious concrete, permeable interlocking concrete pavement, and grid pavements. Fact sheets and checklists help to successfully incorporate permeable pavement systems into design projects. Additional chapters summarize emerging technologies, maintenance considerations, hydrologic design approaches, key components for specification writing, and key areas for additional research. Appendixes include a fact sheet clarifying information on common concerns, as well as data tables summarizing water quality treatment performance and costs.

Permeable Pavements is an essential reference for engineers, planners, landscape architects, municipalities, transportation agencies, regulatory agencies, and property owners planning to implement this best management practice for stormwater and urban runoff.

(ASCE Press, 2015)



Soil-Structure Interaction, Underground Structures and Retaining Walls

Ulitsky, V.M., Lisyuk, M.B. and Shashkin, A.G.

(Proceedings of the ISSMGE Technical Committee)

With construction techniques becoming ever more complex, and population pressure leading to the development of increasingly problematic sites, expertise in the area of soil structure interaction is crucial to architectural and construction industries worldwide.

This book contains the proceedings of the ISSMGE Technical Committee 207 International Conference on Geotechnical Engineering - Soil Structure Interaction and Retaining Walls - held in St Petersburg, Russia, in June 2014. The conference was dedicated to the memory of the outstanding geotechnical expert Gregory Porphyryevich Tschebotarioff.

Topics covered at the conference included: soil structure interaction, underground structures and retaining walls, site investigation as a source of input parameters for soil structure interaction, and interaction between structures and frozen soils.

The papers included here are the English language papers. Papers presented by the authors in Russian are published by the Georeconstruction Institute of St. Petersburg.

(IOS Press, February 2015)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.issmge.org/en/resources/issmge-bulletin/747-vol-9-issue-1-february-2015

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International Journal of GEOMATE

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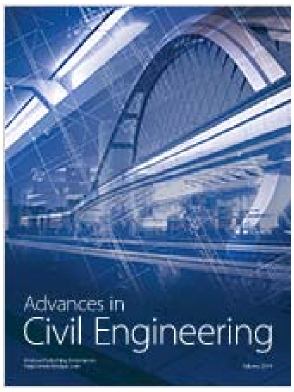
The journal will also be printed in hard copies in two volumes per year. Corresponding author is entitled to receive one volume of the printed journal free of charge.



Dear Dr. Tsatsanifos,

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Best regards,

Alaa Mousa
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