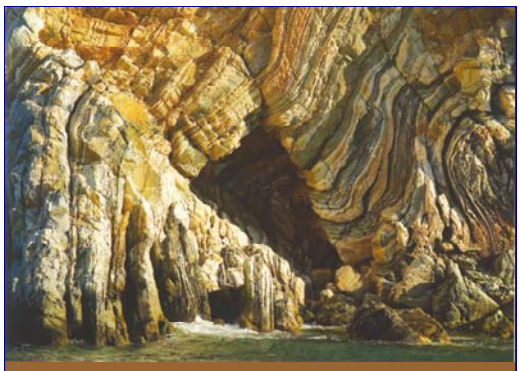

Πτυχώσεις στην Ηρακλειά

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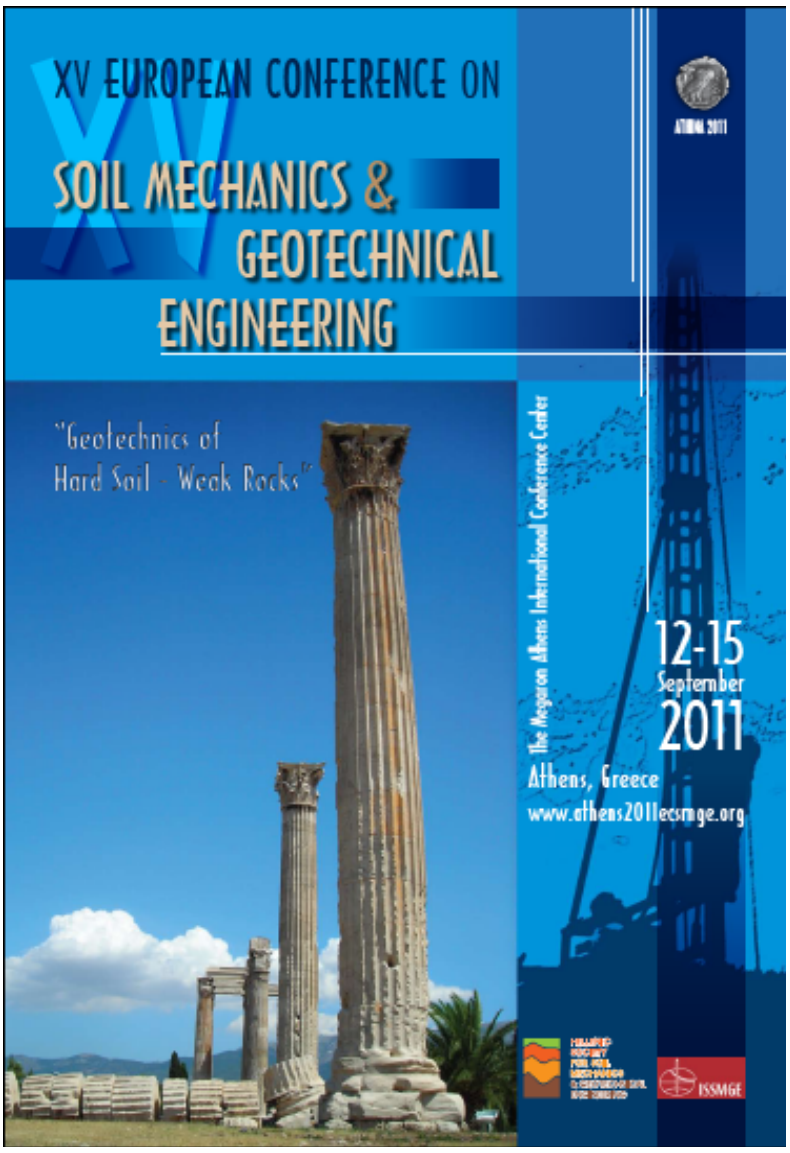
Αρ. 39 – ΣΕΠΤΕΜΒΡΙΟΣ 2011

SIMSG ISSMGE



CONTENTS

ΕΠΙΚΑΙΡΟΤΗΤΑ

XV ECSMGE

Διεξήχθη με εξαιρετικά μεγάλη επιτυχία, παρά τις πολύ μεγάλες αντιξοότητες, το **15ο Πανευρωπαϊκό Συνέδριο Εδαφομηχανικής και Γεωτεχνικής Μηχανικής** με την συμμετοχή 500 περίπου συνέδρων, εκ των οποίων 180 Έλληνες και οι υπόλοιποι από 33 ευρωπαϊκές χώρες, 2 αμερικανικές, 13 ασιατικές, 2 αφρικανικές και 2 της Ωκεανίας.

Οι κριτικές από τους συνέδρους ήταν διθυραμβικές! Παραθέτουμε, στη συνέχεια, κάποιες από αυτές:

Thank you very much for the wonderful conference in Athens which I enjoyed very much! *Dietmar Adam, Αυστρία*

I would like to congratulate you for the excellent organization of the recent ECSMGE. It was a great pleasure for me to have been in Athens and to participate to the Conference. Many of the lectures were very interesting and the discussion in the large part of the sessions was very stimulating. *Stefano Aversa, Ιταλία*

Your event was indeed outstanding as well as your great hospitality. My wife and me remember these days with great pleasure. *Prof. Heinz Brandl, Αυστρία*

Let me add my thanks to those of my friend Roger who said it so eloquently. It was very well done in many ways. You managed to create an atmosphere filled with class and fun at the same time. Memorable indeed. With warm regards. *Jean-Louis Briaud, President ISSMGE, ΗΠΑ*

I just want to thank you for the wonderful Conference you and your team have put on last week. Despite the economic crisis, the Conference was a testimony of the Greek capability, punctuality, organisation and imagination! It was a great advert as to what our country can do if we put our hearts to it and all work together – pity our politicians don't!

So congratulations again, I am always very proud to be Greek and always try to be a good ambassador of our country, of course, but last week you made me feel even more proud that my country, despite all odds and against many people's disbelief can put up such a spotless 'show' despite the dire economic situation. On the build up to the Conference some people laughed at me when I mentioned conference in Athens and others worried about their safety – I stood proud each time and convinced them that this Conference, just like the Olympics, will be a geotech event to remember for many years to come, I think I was right! *Yuli Doulala-Rigby, Ηνωμένο Βασίλειο*

I want to congratulate you and thank you for the very great success of the XV European Conference you organised. It was truly excellent on all aspects! I enjoyed every moment of it.

As I also felt somewhat involved, for various reasons you know, I was very proud to show to all our foreign guests how all practical things were so well organised and technical/scientific matters so interesting.

Given the extremely difficult economic situation in Greece, in Europe and other parts of the world, especially in the construction sector, the merit of your great success is even higher.

The XV ECSMGE in Athens will certainly remain a milestone in my professional career and for my ... private life. *Roger Frank, Γαλλία*

First of all let me congratulate you for an outstanding Conference that I personally enjoyed very much at all levels. Everything worked perfectly and on time and one could feel the warmth of Greek hospitality throughout. *Antonio Gens, Ισπανία*

Congratulations for the optimal organisation and management oft the ECSMGE. Everything was perfect. I will never forget the very nice time in Athens. *Rolf Katzenbach, Γερμανία*

Many congratulations on organising such an excellent conference. Everyone thoroughly enjoyed it. *Robert Mair, Ηνωμένο Βασίλειο*

The XV ECSMGE was a great success and most enjoyable – well done to you and your committee for the good organisation and the excellent venue. Having been secretary of the IX ECSMGE in Dublin, I know that such a conference involved a lot of work for you. *Trevor Orr, Ιρλανδία*

I would like to renew my congratulations for the excellent Conference, in spite all the difficulties that you have faced. I strongly believed that all the delegates will have wonderful souvenirs from Athens and Greece. I take this opportunity to thank you for the warm hospitality that I have received during my stay in Athens. *Pedro Sêco e Pinto, Immediate Past President ISSMGE, Πορτογαλία*

Thank you so very much for your fantastic collective organisation of the European Regional Conference of ISSMGE. You really made the whole conference a tremendous success in spite of the huge adversities thrown your way. Your commitment to the conference was clear and evident and I am sure all the delegates appreciated your huge efforts. I believe all the sessions were successful. Certainly all the delegates I talked to spoke very highly of the conference and expressed their enjoyment of the event as a whole.

Also, thank you for being perfect hosts. All the arrangements were excellent and I felt very well looked after and had a very enjoyable time. The venues for the conference, welcome reception and gala dinner were perfect and clearly chosen with tremendous care and the gala meal and sustenance from the cultural evening were a delight. *Neil Taylor, General Secretary ISSMGE, Ηνωμένο Βασίλειο*

Safely back in Prague, I would like to express once again my deep thanks for all what you did in the phase of EC preparation and realisation. I believe that also last phase - conference evaluation - will go by the same way. I hope to stay in close contact also in future. *Ivan Vanicek, Vice President ISSMGE for Europe, Τσεχία*

Returning from Athens, the very first thing I am so pleased to do is to sincerely congratulate you with this marvellous European conference, organised so brilliantly in such difficult social and political circumstances.

The conference was also content wise of a high and well appreciated level, with lots of mile stones during the key lectures and even at some of the discussions sessions. Really, congratulations for this marvellous accomplishment.

Moreover, personally my wife and I would like to thank you for the hospitality so profoundly present in the Greek life style.

Thank you for all and wishing you a very well deserved period of rest first of all! *William Van Impe, Past President ISSMGE, Past President FedIGS, Βέλγιο*

Περισσότερα στοιχεία και πλήρης απολογισμός για το συνέδριο θα παρουσιασθούν στο επόμενο τεύχος των ΝΕΩΝ.

ΠΡΟΣΕΧΕΙΣ ΕΚΔΗΛΩΣΕΙΣ ΕΛΛΗΝΙΚΟΥ ΕΝΔΙΑΦΕΡΟΝΤΟΣ

Η Εκτελεστική Επιτροπή του ΕΤΑΜ είναι στην ευχάριστη θέση να ανακοινώσει την διεξαγωγή δύο Ημερίδων, σε Αθήνα (2/12/2012) και Θεσσαλονίκη (09/12/2012) αντίστοιχα, με θέμα την «Εφαρμογή του Ευρωκώδικα 8 για τον σχεδιασμό και την αποτίμηση έργων πολιτικού μηχανικού».

Σημειώνεται ότι εκτός από τις προγραμματισμένες ομιλίες, έχει ληφθεί μέριμνα να πραγματοποιηθούν τρείς (3) δεκάλεπτες τοποθετήσεις από μέλη του ΕΤΑΜ σε ειδικότερα θέματα τα οποία δεν περιλαμβάνονται στο κυρίως πρόγραμμα και τα οποία αναμένεται να προταθούν από τα ίδια τα ενδιαφερόμενα μέλη. Η επιλογή των πρόσθετων αυτών εισηγήσεων θα γίνει από την Ε.Ε. του Ε.Τ.Α.Μ. κατόπιν ηλεκτρονικής υποβολής εκ μέρους των ενδιαφερομένων μιας περίληψης του περιεχομένου της εισήγησής τους. Η προθεσμία για την υποβολή της περίληψης αυτής είναι η 15/10/2011 ενώ τα ενδιαφερόμενα μέλη του ΕΤΑΜ παρακαλούνται να την απευθήνουν προς τον Μ. Βουγιούκα (manolis@mail.ntua.gr) ή τον Α. Σέξτο (asextos@civil.auth.gr).

Τέλος, σημειώνεται ότι μετά το πέρας της Ημερίδας της 02/12/2012 στην Αθήνα, θα πραγματοποιηθεί η ετήσια Γενική Συνέλευση του Ε.Τ.Α.Μ.

Με συναδελφικούς χαιρετισμούς,

Κυριαζής Πιτιλάκης, Πρόεδρος Ε.Τ.Α.Μ.
Αναστάσιος Σέξτος, Γραμματέας Ε.Τ.Α.Μ.

Ταρακούνημα στα θεμέλια της Γεωτεχνικής Εκπαίδευσης!

SHAKING THE FOUNDATIONS of Geo-Engineering Education

Πότε; Από 4 έως 6 Ιουλίου 2012

Πού; Στη μαγευτική δυτική ακτή της Ιρλανδίας (National University of Ireland, Galway)

Μα, για τι πρόκειται; Συνέδριο που διοργανώνεται από την Επιτροπή της ISSMGE για την Εκπαίδευση (TC 306)

Πώς μπορεί ο καθένας να συμβάλει στο ταρακούνημα; Με την υποβολή άρθρου (η προθεσμία υποβολής περιλήψεων είναι 31 Αυγούστου 2011) και με την ενεργό συμμετοχή στο συνέδριο, που περιλαμβάνει συνεδρίες-workshop σχεδιασμένες ειδικά για τη δομημένη κατάθεση απόψεων και εμπειριών και την εξαγωγή συμπερασμάτων.

Τι θα χάσουν όσοι δεν έρθουν; Προσκεκλημένες ομιλίες από κορυφαίους εκπροσώπους της Γεωτεχνικής Μηχανικής (John Atkinson, John Burland, Paul Mayne, Brian Simpson) και της Εκπαίδευσης του Μηχανικού (Rich Felder, Steve Ressler). Ακόμα, τη δυνατότητα να επιλεγεί το άρθρο τους για προσκεκλημένη ομιλία (επιπλέον των παραπάνω) και/ή για δημοσίευση του αναμορφωμένου άρθρου σε επιστημονικό περιοδικό. Πάνω από όλα, όμως, δεν θα έχουν την ευκαιρία να λένε μετά «ήμουν κι εγώ εκεί…».

Περισσότερες πληροφορίες; www.sfge2012.com, mpanta@central.ntua.gr

Μαρίνα Πανταζίδου

ΑΡΘΡΑ

ΑΦΙΕΡΩΜΑ ΣΤΑ ΦΡΑΓΜΑΤΑ

Lessons learned from the earthquake performance of concrete dams

Kenneth D. Hansen and Larry K. Nuss

In an update to a 1979 paper on the response of concrete dams to earthquakes, Kenneth D Hansen and Larry K Nuss present details on the earthquake performance of six dams, and discuss their significance for the dam engineering profession

An important paper was published in the April 1979 issue of International Water Power and Dam Construction entitled Response of Concrete Dams to Earthquakes. Authored by Kenneth D Hansen and Louis H. Roehm, the paper reported on the performance of 17 concrete dams in nine countries that had been subjected to ground shaking in excess of 0.10 g. Specific case histories were presented for the following six dams that were shaken severely up to that time and the performance noted:

- Lower Crystal Springs Dam, USA (1906*) – curved gravity dam,
- Blackbrook Dam, England (1957) – straight gravity dam,
- Hsinfengkiang Dam, China (1962) – concrete buttress,
- Koyna Dam, India (1967) – straight gravity dam,
- Pacoima Dam, USA (1971) – arch dam,
- Ambiesta Dam, Italy (1976) – arch dam.

From the recorded performance of these and the other dams listed in a table, it was concluded, in general, concrete dams had performed extremely well when subjected to earthquake motions, even when shaken by forces far in excess of their design loading.

Thirty-two years later, many more earthquakes have occurred which have shaken concrete dams of all types worldwide to a greater extent. Now 19 dams are listed in Table 1 that were shaken by peak horizontal ground accelerations (PHGA) greater than 0.3g. The new list includes five dams from the original table.

Case histories are now presented for the following dams:

- Sefid Rud Dam, Iran (1990) – concrete buttress,
- Bear Valley Dam, USA (1992) – straight gravity (after modification),
- Pacoima Dam, USA (1994) – arch,
- Shih Kang Dam, Taiwan (1999) – multiple bay gravity spillway,
- Kasho Dam, Japan (2000) – straight gravity,
- Shapai Dam, China (2008) – RCC arch.

These dams, similar to the previously reported case histories, were selected based on a number of factors which led to their significance to the dam engineering profession. These factors include importance of the dam, severity of the ground motion, occurrence or lack of observed damage, and availability of quality strong motion records at or near the dam. In addition, a report on the performance of concrete dams subjected to the 2011 Tohoku Earthquake is presented.

Sefid Rud Dam

The performance of Sefid Rud Dam in Iran as shown in Figure 1 is an important case study as the 106m (348ft) high concrete buttress structure suffered appreciable damage due to severe shaking from the M 7.7 Manjil Earthquake of 21 June 1990. Completed in 1962, the dam was designed to withstand a 0.25 g PHGA and is located in the north central region of Iran between the towns of Manjil and Rudbar. The exact location of the epicenter of the earthquake was not determined, but it was close to the location of the dam. The estimated PHGA at the site was back calculated to be 0.714 g based on the nearest record 40km (25 miles) away where a PHGA of 0.56 g was recorded.

Two strong aftershocks having magnitudes in the 6.2 to 6.5 magnitude range occurred several hours after the main shock. In addition, more than 400 aftershocks with magnitudes up to 5.9 were reported in the following weeks by the Geophysical Center of Tehran University. An estimated 40,000 people died due to the earthquake and another 60,000 people were reported as injured. The towns of Manjil and Rudbar were almost completely destroyed.

The dam suffered several types of damage, including horizontal cracks about 18m (59ft) below the dam crest where the inclined buttress intersected the vertical "chimney" section. The cracks were due to a sudden change in stiffness of the structure at this reentrant corner (see Figure 2). No significant displacement occurred in these cracked joints probably due to the high frictional resistance in the horizontal concrete joints between the buttresses. Minor displacement both in the upstream and downstream direction occurred in a few of the 23 blocks. The accumulated displacement in blocks 10 through 20 was 10mm (0.4 inch). Leakage was reported through some of the cracks. Other damage included minor damage and displacement of all the gates, varying types of damage at the dam crest, and damage in the switchyard and to transformers. Repairs were made in 1991 by grouting the cracks and installing prestressed anchors in the cracked areas. The repaired dam remains in service at this time.

Bear Valley Dam

Bear Valley Dam located in southern California, US, as shown in Figure 3 is significant in that it was shaken by two distinct earthquakes one day apart. Bear Valley Dam is a 28m (92ft) high concrete multiple arch dam that was completed in 1912 and modified in 1988. The modification was due to the concern with adequacy of the dam when subjected to the design earthquake or overtopping by large floods. The structural upgrade consisted of converting the multiple arch to basically a gravity structure by partially infilling the arch bays with conventional concrete.

The strengthening of the dam considered two maximum credible earthquakes (MCE). The controlling seismic shaking was an M 8.3 earthquake on the San Andreas Fault 16m (10 miles) away with a PHGA of 0.45 g and 35 seconds of strong shaking.

On 28 June 1992, the fault rupture on the Landers earthquake (M 7.4) located 45km (28 miles) away shook the dam. Then on 29 June 1992 the M 6.6 Big Bear Earthquake occurred about 14.5m (9 miles) from the dam site on a unnamed fault in response to the rupture on the Landers Fault.

Thorough post earthquake investigations indicated Bear Valley Dam had not been damaged. The only indication of

shaking at the site was a slight displacement of girders on the highway bridge located at the dam crest.

At the Big Bear Lake Civic Center located about 4km (2.5 miles) from the dam, PGA of 0.18 g horizontal and 0.08 g vertical was recorded during the Landers Earthquake and 0.57 g horizontal and 0.21 g vertical due to the closer Big Bear Earthquake.

Pacoima Dam

Pacoima Dam, also located in southern California, US as shown in Figure 4 is of interest because it has been shaken by two major earthquakes, the 9 February 1971 San Fernando Earthquake of M 6.6 and then the 17 January 1994 Northridge Earthquake of M 6.8. The performance of the 113m (372ft) concrete arch dam was described in the 1979 Hansen-Roehm article. At that time a number of engineers questioned the validity of the peak accelerations of 1.25 g horizontal and 0.70 g vertical recorded by accelerometers located 16m (52ft) above the dam crest on the left abutment.

Since the 1971 seismic event, an extensive seismic instrumentation system was installed and the upper rock mass of the left abutment was secured to more competent rock below through the use of 35 rock anchors.

The epicenter of the 1994 Northridge Earthquake was determined to be 18km (11.4 miles) southwest of the dam at a focal depth of 17km (10.5 miles). Strong motion records indicate a peak horizontal ground acceleration of 0.53 g at the base of the dam. The acceleration records from the instrument at the upper left abutment measured a peak acceleration of 1.58 g due to the topographic amplification in the canyon. Peak accelerations of greater than 2.3 g horizontal were recorded at the dam crest. The records from the 1971 San Fernando Earthquake are no longer being questioned.

Despite being subjected to high accelerations, the arch dam survived the earthquake well with the main damage being an opening of the contraction joint between the arch dam and the thrust block at the left abutment of approximately 50mm (2 inches) (see Figure 5). A downward movement of about 13mm (0.5 inches) indicates that the thrust block and underlying rock mass may have moved away from the dam. The water level at the time of the 1994 earthquake was approximately two-thirds the maximum depth of the dam and 4.1m (13.5ft) higher than the reservoir level during the 1971 earthquake.

Mojtahedi and Fenves (1995) studied the response of Pacoima Dam using recorded ground motions obtained at the dam site. The analyses indicated opening-closing of contraction and horizontal joints and non-uniform seismic input. A reasonable agreement was obtained between the accelerations recorded on the dam body and the computed accelerations.

Shih Kang Dam

Shih Kang Dam (see Figure 6) in Taiwan is especially relevant to the study of performance of concrete dams subjected to earthquakes as it 1) is the first concrete reported to have failed due to an earthquake and 2) the dam is located directly over a branch of the fault caused by the M 7.6 Chi Chi (also called 921) earthquake on 21 September 1999. The 21.4m (70ft) high gravity dam is essentially an 18-bay gated spillway.

The main Che-Lung-Pu fault located about 300m (1000ft) away from the structure was known at the time of the design of the dam, but not the branch that ruptured under the dam. The fault rupture extended both upstream and downstream of the dam and caused extensive damage to bays 16 to 18 on the right side of the structure. The ground movement raised the left part of these bays about 11m (36ft) and the right side by about 2m (7ft). Thus, there was a vertical differential movement of about 9m (29ft) in this area. There was also a diagonal horizontal offset through the dam of about 7m (23ft). A PHGA of 0.51 g and a peak vertical acceleration of 0.53 g were recorded 500m (0.31 miles) from the dam site.

The remaining portion of the dam adjacent to the damaged area also experienced high accelerations and separated from its foundation bedrock. There was some cracking in the piers closest to the fault rupture, but no structural damage. Simply supported reinforced concrete bridges spanning the spillways all came off their bearings. Six gates were inoperable after the earthquake.

Considering the magnitude of the displacement, the performance of the dam was quite remarkable. It did not fail as indicated by the definition of failure as a complete loss of the reservoir water. Due to the upstream topography as well as the gates and piers falling into the passageway the flow through this area was limited to an estimated 100 to 200m3/sec (3,500 to 7,000ft3/sec.)

The performance of Shih Kang Dam seems to confirm what had been postulated by Zienkiewicz, Clough, and Seed inICOLD Bulletin 52 (1986) "Earthquake Analysis Procedures for Dams – State of the Art". The authors noted "we shall not consider the possibility of a large differential movement occurring in a fault transversing the dam foundation. In particular the possibility of a movement on a fault zone should at all times be avoided by a suitable geological study. Often, it is speculated that in the event of such a movement, 'soft' structures – e.g. earth dams – are safer than more rigid concrete ones. This prediction is however beyond the realm of calculations which are feasible at present and it certainly is possible that a concrete gravity dam is safer than an earth dam in such a fault movement due to its inherent stability after damage."

Kasho Dam

Kasho Dam as shown in Figure 7 is significant in that it is the second concrete dam, the first being Pacoima Dam, in which an acceleration greater than 2.0 g was recorded at the dam crest during an earthquake. Kasho, a 46.4m (152ft) high concrete gravity dam was shaken by the 6 October 2000 Western Tottori Earthquake (M 7.3) in Japan. The epicenter of the earthquake was about 3km (1.9 miles) from the dam. Numerous aftershocks were recorded with one having a magnitude greater than 7. At the time of the earthquake, the reservoir was nearly 5.8m (19ft) below normal pool.

Peak accelerations of 0.54 g horizontal and 0.49 g vertical was measured in the lower inspection gallery located nearly 9m (30ft) above the base of the dam and 2.09 g in an elevator shaft at the crest of the dam.

Using accelerations measured in the lower inspection gallery from the main shock as well as aftershocks, the natural periods of vibration were 0.84, 0.96, 0.92, and 0.87 seconds. The first period first increased and then decreased. It was theorized with a high degree of probability that the change in period was due to the nonlinearity of the hydrodynamic pressure acting on the upstream face of the dam. Measurements indicated the water level in the upper portion of the reservoir dropped about 200mm (8 inches) and nearly 60mm (2.4 inches) at the dam. From plumb line readings in the dam the main shock produced a relative displacement of 28mm (1.1 inches) toward the right abutment and 0.7mm (0.28 inches) in the upstream direction. The maximum displacement was a little more than 29mm (1.125 inches). There was basically no damage to the concrete gravity dam. The walls at the base of the control room, a reinforced concrete structure cantilevering up-

stream from the crest of the dam, were cracked (see Figure 8).

Two other concrete gravity dams, the 73.5m (341ft) high Sugesawa Dam and the 14m (46ft) high Uh Dams were also located close to the earthquake epicenter. There was insignificant damage at Sugesawa Dam with PHGA of 0.16 g consisting of a small 1m by 0.3m (3.3ft by 1ft) concrete spall on the downstream face of the dam. Uh Dam is located about 1.0km (0.6 miles) from the earthquake epicenter. Seismographs recorded peak accelerations at the surface of 1.16 g and at a depth of 100m (330ft) of 0.62 g. Although Uh Dam was subjected to severe shaking, the only damage to the dam was cracking 10 to 30mm (0.4 to 1.2 inch) wide on the spillway channel near the base of the downstream face.

Shapai Dam

Shapai Dam as shown in Figure 9 is the first roller-compacted concrete (RCC) dam shaken by a major earthquake. The dam located in Sichuan Province, China is a 132m (433ft) high three-centered RCC arch dam completed in 2003. It is located 12km (7.8 miles) from the Wenshuan (also called Sichuan) earthquake that occurred on May 12, 2008. The M 8.0 earthquake killed more than 80,000 people and about 675,000 were injured.

The PHGA at the site was estimated to be about 0.8 g compared to the design acceleration of 0.13 g. With a nearly full reservoir at the time of the earthquake, the dam was undamaged. One of the spillway gantries was slightly damaged. However, all gates could be opened after the shaking. The power station was badly damaged when large rocks rolled down the steep mountain site knocking holes in the building walls.

The Tohoku Earthquake

As this article was being prepared, the M 9.0 Tohoku earthquake of 11 March 2011 occurred in the Pacific Ocean 131km (81 miles) east of Sendai, Japan. The earthquake triggered tsunami waves up to 10m (33ft) high when it hit shore that caused extreme destruction.

Following the earthquake, more than 400 dams were inspected. No damage was reported to any concrete dam except a minor slope failure at one reservoir formed by a concrete dam. Many of these dams are concrete dams as about 37% of all dams and 60% of dams greater than 30m (100ft) high in Japan are concrete structures.

Aydan (2011) published a map of the location of maximum ground accelerations color coded from 50 to 800 gal (0.05 to 0.8 g). The area of maximum ground acceleration is located about 48 km (30 miles) north of Sendai.

The authors determined that Miyatoko Dam (see Figure 10), a 48m (157ft) high RCC dam was located approximately 13km (8 miles) north of Sendai. From Aydan's map, this would place this concrete dam in an area where the PHGA was greater than 0.7 g. There are many other concrete dams located in Miyagi, Fukashima and Iwate Prefectures which apparently were subjected to PHGAs in excess of 0.3 g. All were not damaged by this event which has been reported as the fifth greatest magnitude earthquake on record. A recent paper from Japan indicates the 77m (252ft) high Takou concrete gravity dam was shaken by a PHGA of about 0.4 g using Aydan's map. Takou Dam suffered no damage except cracking in the walls of the gate house located on the crest of the dam. The PHGA's for Miyatoko and Takou Dams, and possibly others in Japan, will need to be confirmed at a later date.

Conclusions

Since the 1979 article was published, many large magnitude earthquakes have occurred as expected. With a greater number of higher quality strong motion instruments located at or near dams, our base of knowledge of the magnitude of shaking to which concrete dams have been subjected has increased. Thus, our knowledge of the performance of severely shaken concrete dams has increased and this knowledge can be applied in a positive and beneficial manner to the design of future dams.

While many previous reports on the performance of dams subjected to major earthquakes focused on the magnitude of the earthquake and a not so precise distance to the dam, it has become apparent the most significant factor in determining the response of concrete dams is the PHGA and probably the spectral acceleration at the natural frequency of the dam.

While the 1979 article provides a list of 17 dams shaken by an acceleration measured or estimated to be in excess of 0.1 g, Table 1 lists 19 dams shaken by PHGAs greater than 0.3 g. In general, it can be concluded that concrete dams have performed very well when subjected to high intensity accelerations. The threshold of no damage is project specific, but can quite probably be significantly higher than 0.3 g for properly designed and constructed concrete gravity and arch dams.

Concrete buttress dams when subjected to severe shaking have developed horizontal cracks at the elevation high in the dams where the downstream buttresses intersect the vertical "chimney" section. This is an area where the stiffness of the concrete structures significantly changes.

Some other specific conclusions are:

- While a fault located directly below Shih Kang Dam (Taiwan) caused a rupture and relative vertical displacement of 9m (29ft), the remaining damaged concrete limited an im-mediate total and sudden release of the reservoir.
- PHGAs are amplified from the base of the dam to the crest. In two cases, this amplification produced measured peak accelerations at the crest in excess of 2.0 g (Pacoima arch dam – USA (2.3 g) and Kasho gravity dam – Japan (2.05 g)).
- Peak accelerations, as expected, at the crest are greater with full reservoirs.
- Several dams have been severely shaken on two occasions by separate major earthquakes – Bear Valley Dam – USA (one day apart) and Pacoima Dam – USA (23 years apart) with only minor damage. Many concrete dams have also been shaken by high intensity aftershocks that oc-curred after the main earthquake without any additional damage.
- Roller-compacted concrete dams – Shapai arch in China and Miyatoko Dam in Japan performed no differently to date than a dam built of conventionally placed concrete despite concern by some of less strength at the many lift joints.
- Where damage has been identified, it has been cracking high in the dam and where additional features such as curbs, railings, gates, or guard or control houses are located.
- Very little in the way of increased leakage has occurred in concrete dams subjected to major earthquakes. This can be attributed, in part, to the fact that any cracking caused by the earthquake has mainly been horizontal and located high in the dam together with the reservoir not being full in many cases. Some rock foundations have

experienced a temporary increase in seepage following an earthquake.

There may be a number of reasons why concrete dams have performed well and invariably better than that predicted by design or analysis when shaken by an earthquake. The main reasons may be 1) the redundancy of the damaged structure to redistribute load, 2) the duration of strong shaking being too short to cause failure, 3) the increase in the tensile strength of the concrete during dynamic loading that increases resiliency, 4) an increase in the damping that reduces the seismic impact on the dam, 5) reduced seismic impact because the natural frequency of the dam does not match the frequency of the earthquake, and 6) three-dimensional effects of canyon confinement or dam geometry (curvature) that help prevent failure.

A generally accepted potential failure mode for concrete dams during an earthquake is cracking of the concrete, cracking through the dam that forms removable blocks, sliding of the blocks during or after the earthquake to cause failure. Severely shaken concrete dams to date have cracked at locations of change in geometry (reentrant corners), but have not formed removable concrete blocks. Thus the entire potential seismic failure mode has not been fully achieved or experienced for concrete dams.

Commentary

Earthquakes are natural phenomena that will continue to occur and cause extensive loss of life, damage to buildings and all types of infrastructure. Currently, there is no real way of predicting earthquakes. We can just design our structures including dams to withstand severe seismic shaking.

When a major earthquake occurs, there are all kinds of devastation as was recently recorded following the M 9.0 Tohoku earthquake off the coast of Japan. This resulted mainly from an earthquake induced tsunami that caused extensive damage after washing ashore for a maximum distance of nearly 10 km (6 miles).

Concrete dams have performed very well when subjected to high intensity earthquakes as noted in this paper. We do not need to have a concrete or any type of dam fail and release a wave of water rushing downstream that would add to the devastation already caused by the intense seismic shaking and other earthquake induced phenomena.

While concrete dams are designed to withstand a higher degree of seismic shaking than buildings and have performed well in the past, we should not become overconfident of their performance in the future. Great care should be taken in the design details and quality of construction. Particular attention should be given to possible faults located under the dam.

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FOOTNOTE

* Date of earthquake - typical

(International Water Power & Dam Construction, 27 September 2011)

Dam Safety: Stability and Rehabilitation of "Smaller" Gravity Dams

Gregory S. Paxson, David B. Campbell, Michael C. Canino, and Mark E. Landis

Gravity dams about 100 feet high and smaller often require special considerations when evaluating stability and rehabilitation of these structures. Three case histories are presented that illustrate some of the unique challenges in the stability evaluation and upgrading of these dams.

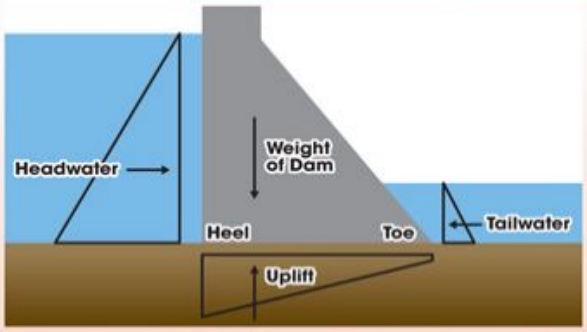
This article has been evaluated and edited in accordance with reviews conducted by two or more professionals who have relevant expertise. These peer reviewers judge manuscripts for technical accuracy, usefulness, and overall importance within the hydroelectric industry.

For many, the terms "gravity dam" and "concrete dam" conjure images of large structures, such as the Hoover and Grand Coulee dams. However, most masonry and concrete gravity dams in the U.S. are much smaller structures. According to the National Inventory of Dams, 90 percent of gravity dams categorized as high or significant hazard structures are less than 100 feet tall.[1]

Design features common to large gravity dams often are not incorporated into these smaller structures. For example, many smaller dams do not include foundation drainage systems. In addition, large dams in steep canyons typically are keyed into bedrock at the abutments, while for smaller structures the non-overflow sections may only extend a limited distance beyond the original ground surface and many times are not abutted into sound rock.

Geologic investigations and methods for stability evaluation often are less rigorous and complex for smaller structures. The behavior of larger dams necessitates a better understanding of the foundation conditions and a more in-depth analysis of the performance of the structure under various loading conditions, including finite element and deformation analyses. This article discusses the stability analysis and rehabilitation of smaller (less than 100 feet tall) gravity dams.

FIGURE 1 Typical Forces for a Gravity Dam



For any size of gravity dam, typical forces included in a two-dimensional stability analysis include headwater and tailwater, weight of the dam, and uplift.

Gravity dam stability analysis

The most common failure mode for gravity dams is sliding or overturning along or beneath the dam/foundation interface.[2]Stability analysis for gravity dams often is simplified into a two-dimensional rigid body analysis of a cross section of the structure (see Figure 1) and is focused on stability against sliding. In this analysis, overturning of the dam is considered within the context of its potential influence on sliding. Overturning tendencies express themselves through development of tensile stresses at the heel of the dam. In these cases, sliding stability is analyzed considering a cracked base, which reduces sliding resistance. While the gravity dam stability analysis often is simplified to evaluate failure along the base, it is important to consider kinematically feasible failure mechanisms along joints, foliations and bedding planes or within the rock mass.[3]

In addition to failures through the foundation and along the dam/foundation interface, the stability analysis should consider failure through the dam, commonly along horizontal construction joints. This "partial section" analysis usually is performed using the same methods applied to the stability evaluation of the entire structure.

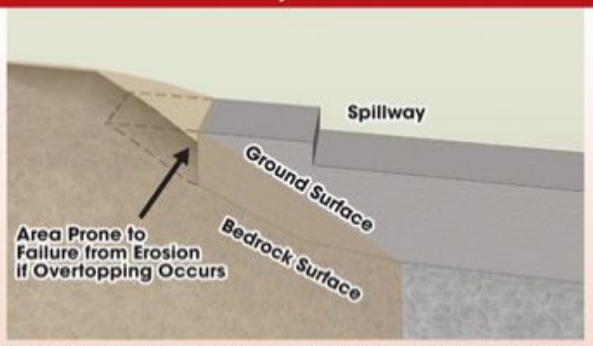
Guidance documents for the evaluation and design of gravity dams have been developed by U.S. agencies that own or regulate dams, including the Federal Energy Regulatory Commission, Bureau of Reclamation, and U.S. Army Corps of Engineers. In Canada, the Canadian Dam Association and BC Hydro provide similar guidance for the evaluation of gravity dams.[3,4]

Material properties

The selection of physical and mechanical properties of the dam and foundation are critical to the stability evaluation of a gravity dam. Unit weight of the concrete or masonry is a key component of the analysis. Estimates of the shear and tensile strength of concrete in the dam can be estimated from laboratory testing of representative samples and/or using available guidance documents.[4,5,6]

The shear strength along the dam-foundation interface or through the foundation is probably the most important parameter to define. Shear strength is comprised of the friction angle and cohesion of the material(s) or interface. Typical shear strength values are available.[6,7,8] Friction angle often is estimated using material testing and/or correlation with empirical data for similar materials. Estimating cohesion (or adhesion along the base of the dam) is more difficult, and the selected value has a significant effect on the stability analysis results. FERC recognizes the difficulty in accurately defining cohesion along the base of the dam and provides alternate requirements for stability if cohesion is not relied upon in the analysis.[9]

FIGURE 2 Gravity Dam Abutment



The area between the end of a gravity dam and the bedrock surface is susceptible to failure from erosion during extreme floods when overtopping would occur.

Loading conditions and safety factors

Most regulatory agencies, including FERC, categorize loading conditions as "usual," "unusual" and "extreme," and the required safety factor increases with the probability of a given loading condition. Typical loading combinations to be considered include normal operating conditions (usual), flood discharge loading (unusual or extreme), loading from ice (unusual) and earthquake forces (unusual or extreme).

The stability analysis for flood conditions should consider a range of floods to identify the combined reservoir (headwater) and tailwater loading that results in the lowest safety factor. The largest hypothetical flood, or probable maximum flood, is not always the most critical flood loading scenario.

As noted earlier, FERC guidelines allow a reduction in the required safety factor if cohesion is not considered in the analysis. For example, the minimum required safety factor

for normal operating conditions is 3.0 if cohesion is included but otherwise only 1.5.

Uplift forces within the dam, on the base of the structure, and within the foundation rock mass are important in stability evaluations. For structures without an internal drainage system or other special features, and with fairly uniform foundation conditions, it is typical to assume that uplift varies linearly from full headwater at the heel to full tailwater at the toe of the dam. For dams with a drain system, reduction in these pressures should only be allowed when it can be verified that the drain system is effective.

Cracked section analysis

The gravity method of analysis requires that the resultant of all forces acting on the dam lie within the middle one-third of the base to avoid tensile stresses at the heel. When the resultant lies outside the middle one-third, tensile stresses are assumed to develop along the base of the dam. Most regulatory agencies (including FERC) require a cracked section (or cracked base) analysis when tension develops at the heel of the dam. Full uplift is then assumed to act on the cracked section of the base (except under seismic loading, where full uplift is assumed not to develop due to the rapid cycling from seismic loads), and the analysis is revised to reflect this modified uplift distribution, with cohesion, if considered, acting only along the uncracked portion of the base.

Most agency guidance suggests an iterative approach to the cracked section analysis for static loadings. However, the crack length and reaction pressure at the toe of the dam can be solved explicitly.[10,11] For earthquake forces, the crack length can more easily be computed.

Rehabilitation of gravity dams

The most common methods for rehabilitation of gravity dams that do not meet stability criteria include buttressing or anchoring. Buttressing consists of adding mass to the downstream portion of the structure to resist sliding. This can be accomplished using conventional mass or roller-compacted concrete. High-capacity post-tensioned rock anchors have been used to stabilize gravity dams since the 1960s, with more than 300 dams in North America being anchored.[12]Vertically installed post-tensioned anchors add normal force, increasing the sliding frictional resistance and preventing the development of tension at the heel of the dam. Anchors installed at an angle will provide additional sliding resistance by directly offsetting applied horizontal forces, but installation can be more costly than vertical anchors.

Gravity dams with inadequate spillway capacity can be allowed to overtop during extreme floods, provided the dam meets stability criteria under the flood loading conditions and overtopping flows can be shown not to erode foundation support from the toe of the dam or abutments.

For many smaller gravity dams, the non-overflow sections do not extend to bedrock at the abutments but are simply buried in the earth abutment (see Figure 2). This typically is acceptable, provided the fill materials are satisfactory and the spillway can pass the design flood without overtopping the non-overflow sections or abutments. If these sections do overflow, there is potential for erosion and failure of the earth abutment, resulting in a potential dam failure or loss of reservoir. In some cases, these dams have cutoff walls that extend further into the abutments than the gravity section. However, these walls typically are intended to reduce abutment seepage rather than prevent erosive failure from overtopping. Dams lacking non-overflow sections that tie into bedrock abutments may require modifications to prevent overtopping or erosion of the earthen abutment.

Case histories

The following case histories include discussion of the gravity dam stability analysis, the importance of parameter selection, rehabilitation to address stability issues and the potential for abutment erosion and failure.

Sugar Hollow Dam

Rivanna Water and Sewer Authority owns Sugar Hollow Dam near Charlottesville, Va. This 80-foot-high concrete gravity dam was completed in 1947 and consists of spillway and non-overflow gravity sections, with cutoff walls extending into earth abutments. In the mid-1990s, the Virginia Dam Safety program identified the dam as having inadequate spillway capacity, and analyses indicated that the dam did not meet stability criteria for extreme flood loadings.

The authority planned to install 30 vertical multi-strand, post-tensioned rock anchors through the gravity sections to increase the frictional resistance and prevent overturning under extreme flood conditions. Anchor sizes ranged from five to 36 strands, with a maximum design load of about 1300 kips. Anchors were designed, installed and tested in accordance with Post-Tensioning Institute standards.[13]

Because the non-overflow sections would overtop during the PMF, there was potential for erosion and failure of the earth abutments and cutoff walls. Alternatives to address this concern included armoring the abutments, stabilizing the cutoff walls assuming downstream soils eroded, and raising the abutments to prevent overtopping flows of these areas. Raising the earthen abutments by 10 feet with earthfill was found to be the most cost-effective approach. The ends of the non-overflow sections were also raised with concrete to confine overflow to the central valley.

The project received the Association of State Dam Safety Officials award for National Rehabilitation Project of the Year in 2000.

Stony Creek Dam

Stony Creek Dam is a 35-foot-high concrete gravity dam constructed in the late 1920s for water supply. The dam, owned and operated by the City of Burlington, N.C., has a 200-foot-long spillway section with concrete non-overflow sections that tie out to earth abutments. State dam safety regulations require safe passage of half of the PMF. Although the concrete of the dam is in good condition, the non-overflow sections and abutments overtop at about the 100-year storm event, and stability analyses demonstrate the dam does not meet the required safety factor for events greater than an estimated 300-year storm. For the modeled half PMF, the abutments overtop by 12 feet, which would result in a breach of the reservoir.

The rehabilitation design for Stony Creek Dam includes post-tensioned anchors installed in the spillway and non-overflow sections, spaced 10 feet apart with design loads up to nearly 800 kips. The left abutment will be protected by constructing a concrete gravity section extension, and the right abutment will be reinforced by the installation of a 48-inch-diameter secant shaft wall with steel H sections placed in alternate shafts and socketed 15 feet into rock and secondary shafts terminated at the top of rock. The secant wall is designed to provide cantilever resistance at half PMF water levels, with erosion to rock on its downstream side.

Construction of the upgrades to Stony Creek Dam began in spring 2011, and this work is expected to be completed by the end of the year.

A concrete gravity section was built at Stony Creek Dam to tie the dam into the bedrock at the left abutment (foreground). The right abutment will be reinforced using a secant shaft wall, and the spillway will be stabilized with post-tensioned rock anchors.

Green Lane Dam

Green Lane Dam is a 103-foot-high, 800-foot-long concrete gravity dam northwest of Philadelphia. The dam, owned by Aqua Pennsylvania, was constructed in the mid-1950s for water supply. The design flood for this high hazard dam is the PMF, which was re-evaluated in the late 1990s and found to overtop the non-overflow sections of the dam by about 2 feet. A preliminary stability evaluation indicated that the dam did not meet generally accepted criteria, and the owner's previous consultant recommended performing more in-depth field explorations and analyses to support a rehabilitation design. Initial estimates for stabilizing the dam with post-tensioned rock anchors were $1 to $3 million.

As-built drawings and original construction photos indicated that significant rock excavation (15 to 30 feet) was performed. Concrete at the base of the dam was cast against the bedrock, indicating that sliding could not occur without mobilizing a significant rock wedge (shear through bedrock). In addition, the roller bucket energy dissipater in the spillway section has a minimum 5-foot concrete thickness and is anchored into the foundation bedrock, thereby providing supplemental sliding resistance.

At Green Lane Dam, subsurface information obtained and detailed analysis indicated the dam met stability criteria of the Pennsylvania Department of Environmental Protection.

A subsurface exploration indicated that the dam's concrete was of good quality. Most of the horizontal construction joints were unidentifiable by visual inspection, indicating bond at these joints. However, the rock at the concrete/bedrock interface was highly fractured, suggesting that cohesion at the interface could not be relied upon in a stability analysis.

Laboratory testing included unit weight and compressive strength tests of the concrete and rock samples. Concrete samples had an average dry unit weight of 157 pounds per cubic foot (pcf), compared to the typical unit weight of good quality mass concrete of 145 pcf to 155 pcf.

More detailed analyses were performed to estimate downstream flood levels because tailwater can have a significant effect on stability. The HEC-RAS river modeling package, developed by the Corps, was used to model flow in the creek and floodplain downstream of the dam. For the spillway section, the tailwater computed using HEC-RAS was adjusted to reflect effective tailwater against the dam, as influenced by high-velocity flow through the spillway and roller bucket.

Corps guidance suggests that the effective tailwater force downstream of a spillway can be reduced to as little as 60 percent of the depth in the downstream channel, a default value used when supporting documentation is not provided. Using model studies performed as part of the original design and guidance provided by the Corps,[14] the effective tailwater for the Green Lane Dam roller bucket was estimated to be about 85 to 90 percent of the downstream tailwater depth.

The findings of the documentation review, subsurface exploration, laboratory testing and hydraulic analysis provided information that contributed to a refined evaluation of the stability of the structure, including:

- Unit weight of the concrete was higher than expected;
- Tailwater levels during the PMF were higher than assumed in previous analyses; and
- The dam is "keyed" into the rock foundation.

An updated analysis was performed in 2004 incorporating these findings, and the results demonstrated that Green Lane Dam meets the Corps criteria for gravity dam stability, eliminating the need for an upgrade.

Summary and conclusions

Smaller gravity dams commonly are evaluated using simplified two-dimensional analyses with conservative assumptions for strength along the dam/foundation interface and within the foundation rock. For dams not meeting stability criteria, stabilization is often performed using post-tensioned rock anchors or buttressing. In addition to stability concerns, many smaller gravity dams are not "keyed in" to bedrock at the abutments, creating the potential for abutment erosion and failure.

These case histories demonstrate approaches for the rehabilitation of gravity dams with stability issues or potential for abutment erosion. The case history for Green Lane Dam illustrates the importance of detailed review of dam construction records, advanced hydraulic analysis for estimating effective tailwater, and laboratory testing (especially related to unit weight and bond) when it comes to stability analysis results.

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Greg Paxson, PE, a principal with Schnabel Engineering, was a designer for the Sugar Hollow Dam project, performed stability analysis for Green Lane Dam and served as a reviewer for the Stony Creek Dam project. Dave Campbell, PE, director of dam engineering for Schnabel, was the principal-in-charge for the Sugar Hollow and Green Lane Dam projects. Mike Canino, PE, the West Chester, Pa., branch leader for Schnabel, has been involved with the evaluation of numerous gravity dams. Mark Landis, PE, a principal with Schnabel, is the project manager for the Stony Creek Dam project.

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Dam Safety: What Happened to Lake Delhi Dam?

W. Fiedler, W. King, N. Schwanz, J. Garton and L.McDaniel

Record rainfall, faulty gates and inherent design issues contributed to the July 2010 breach of Iowa's Delhi Dam, investigators found. The overtopping caused the earthen embankment to erode and eventually emptied Lake Delhi, causing millions in property damage.

Delhi Dam was breached on July 24, 2010, after two days of heavy rain in the drainage basin above the dam. What follows are details about the dam's history, the Iowa Department of Natural Resources' role in forming and assisting the Independent Panel of Engineers to investigate the breach, the dam breach investigation process, the likely cause of the dam breach and lessons learned.

The dam breach initiated about 1 p.m. on July 24, 2010, with an estimated peak breach outflow of 69,000 feet3/s. The flood and the dam breach resulted in extensive property damage in the reservoir above the dam and in the communities downstream of the dam. No loss of life occurred as a result of the dam breach.

There were a number of factors taken into consideration in the investigation of the breach. These included:

- The design of the embankment dam, which included a reinforced concrete core wall as the primary impervious element in the dam;
- The embankment materials, which appear to have consisted of a low plasticity sandy clay;
- The limited ability of the dam to pass a major flood (given the spillway capacity was initially designed to about 25,000 ft3/s, at reservoir water surface elevation 900 ft), and;
- The binding of one of the spillway gates preventing its full opening during the flood event.

Delhi Dam: History and background

Delhi Dam is on the Maquoketa River, about 1.4 miles south of the town of Delhi. The Maquoketa River in northeastern Iowa is a tributary of the Mississippi River. The dam was constructed between 1922 and 1929 by the Interstate Power Company for hydroelectric power generation.

Generation of power was terminated at the dam in 1968. The dam is currently owned and operated by the Lake Delhi Recreation Association. In 1991, the Lake Delhi Combined Recreation and Water Quality Tax District was formed pursuant to Iowa Code Chapter 357E to allow lake residents to tax their property an additional $4 per $1,000 of assessed value, to support the dam and lake. In 2005 the District issued tax-exempt bonds to finance dredging of the lake.

The flood gates and wicket gates of the dam were damaged in 2008 and dangerous scouring of the underwater rock armor of the dam was discovered. At the invitation of Federal Emergency Management Agency representatives, the Tax District applied for and was approved for repairs to the lake and dam. Several repair projects were completed and additional projects were underway at the time of the 2010 flood.

While the lake frontage was primarily privately owned, public access was allowed and the lake was patrolled by Iowa DNR enforcement officials. The dam was inspected every five years by the IDNR dam safety staff. The last full inspection was in 2009. At this inspection, the need for repairs to the spillway gates were noted, and IDNR required the repairs to be completed by the Lake Delhi Recreation Association by the end of 2009.

Aerial view of Delhi Dam Failure.

Follow-up contact made by the IDNR in January 2010 found that repairs were currently underway but were not completed. The repairs do not appear to have been completed prior to the July 2010 breach of the dam

Delhi Dam was designed as a concrete dam and earthen embankment. The 704-foot long structure consists of: A 60-foot long concrete reinforced earthfill section abutting the left limestone abutment; a 61-foot long conventional reinforced concrete powerhouse containing two S. Morgan Smith turbines with two Westinghouse generators (each rated at 750 kW); an 86-foot long gated concrete ogee spillway with three 25-foot by 17-foot vertical lift gates; and, a 495- foot long embankment section with a concrete core wall.

The embankment section was originally constructed with 1V:3H upstream slopes and 1V:2H downstream slopes, and extends to the south (right) abutment of the dam. The crest of the south embankment section of the dam is 25 foot wide and the dam crest is at elevation 904.8 feet NGVD29.

The maximum section of the concrete portion of the dam has a height of about 59 feet and the embankment section has an estimated maximum height of 43 feet. Lake Delhi, the reservoir behind Delhi Dam has an area of approximately 440 acres and a storage volume of 3,790 acre-feet at normal reservoir (elevation 896 ft) and a reservoir volume of about 9,920 acre-feet at the crest of the dam (elevation 904.8 feet). The spillway crest is at elevation 879.8 feet and the hollow inside of the spillway crest structure is filled with rock.

The concrete reinforced earthfill section of the dam at the left abutment was originally constructed with two parallel concrete retaining walls, founded on rock and spaced 20 ft apart. Rock fill was placed between the walls.

In 1967, a concrete crib wall and additional fill was placed upstream of the original walls.

The area downstream of this section serves as a parking and staging area for performing maintenance in the powerhouse.

Formation of the dam failure investigation team

In response to the dam failure, the Governor of the State of Iowa requested assistance from the National Dam Safety Review Board in providing an Independent Panel of Engineers to evaluate the cause of the overtopping and breach of Delhi Dam. This request was made to the Administrator of the Federal Emergency Management Agency (FEMA)

dated August 6, 2010. The National Dam Safety Review Board includes representatives from federal and state agencies as well as a member from the private sector and operates under the direction of FEMA. The National Dam Safety Review Board is statutorily established under the Dam Safety Act of 2006 (Public Law 109-460) and provides the Director of FEMA with advice in setting national dam safety priorities and considers national policies affecting dam safety.

The breach of Delhi Dam in progress. The core wall is still in place.

In an Aug. 6, 2010, letter, the State of Iowa identified the scope of the Independent Panel of Engineers review as follows:

- Review the operational characteristics of the project leading up to the breach of the upper reservoir.
- Perform an evaluation of the breach of the dam to determine the specific failure mode.
- Submit a final report documenting the results of their findings on the cause of the breach of the upper reservoir and the important lessons learned from the failure.

In a letter from the Deputy Administrator of FEMA to the Director of the Iowa Department of Natural Resources dated Aug. 27, 2010, a commitment was made to convene a three-member Independent Panel of Engineers under the auspices of the National Dam Safety Review Board. The three members represent federal agencies with extensive experience in dam safety and include: William Fiedler, Bureau of Reclamation; Wayne King, Federal Energy Regulatory Commission; and Neil Schwanz, U.S. Army Corps of Engineers.

Each of the respective agencies absorbed the time and travel costs for this investigation. State funding was not used for this investigation.

The investigation process

In order to fulfill its mission, the independent panel initially collected and reviewed key information. The panel operated independently and access to individuals and to any requested information was freely granted.

Areas of focus included: the design and construction of Delhi Dam, subsequent modifications to the dam, the operational and performance history of the dam, past examinations and reviews of the dam, the timeline of events leading up to and including the breach of Delhi Dam and the emergency response to the dam breach.

A key activity for the panel was convening in Iowa during the week of Sept. 6, 2010. On Sept. 7, 2010, the panel reviewed records at the Iowa Department of Natural Resources Offices in Des Moines, Iowa, and conducted interviews with personnel from the IDNR, as well as the dam operators, owner's representatives and local residents. On Sept. 8-9, 2010, the team inspected the dam site and the upstream and downstream areas and conducted additional interviews with personnel from local government agencies and from the Lake Delhi Recreation Association. The team spent Sept 10, 2010, in Des Moines at the Iowa Department of Natural Resources Office and reviewed additional records and conducted additional interviews.

After the information gathering was complete, the panel set out to draft their report. A thorough review of the geotechnical aspects of the original design and past modifications was completed. The original drawings and documentation were not very clear on the original foundation and geotechnical design, Therefore, a soil sample of the remaining embankment was tested and two shallow hand augers of the foundation were obtained.

A hydrology and hydraulic analysis was undertaken by the panel. The analysis utilized a HEC-RAS model developed by the IDNR shortly after the breach. There were many questions that arose after the failure in regards to one of the spillway gates that was not able to be fully opened. It was critical for the panel to complete some "what-if" scenarios to begin to answer those questions. Flow data were available from a U.S. Geological Survey-gage in the City of Manchester upstream of the lake. However, there were also significant local inflows to the lake that had to be estimated.

The panel also provided a review of the emergency management response and a timeline of events based on testimonials and photos.

	July 22 – 24, 2010
	Heavy rain in watershed
	July 24, 2010
3:30 AM	Dam operator observes sag in upstream fence. 4 ft whirlpool discovered, and county emergency manager was notified.
6:00 AM	Exit point of seepage confirmed in downstream toe, dam operator requests public alert for potential dam failure, and 6" sag in road over dam observed.
6:20 AM	National Weather Service issues dam failure flood watch.
9:00 AM	Dirty flow observed at toe of downstream slope.
9:40 AM	Observed 1-2 inches water flowing over the road.
10:00 AM	Significant erosion of the downstream roadway shoulder beginning widening within 10 ft of concrete wall/structure.
11:30 AM	Water flowing through the roadbed, roadway was not likely.
12:00 PM	Heavy flow over top of dam and underneath the road.
12:15 PM	Roadbed collapses.
12:22 PM	Headcut progressed 50% through roadway.
12:45 PM	Headcut progressed 75% through roadway.
1:00 PM	Headcut progressed completely through embankment.
1:02 PM	60 ft wide breach through roadway.
2:40 PM	Breach was reported to be 200 feet wide, lake water level dropped by 25 feet.

Iowa's role of information provider

In order for the investigation team to be completely impartial, the Iowa DNR facilitated the process to gather witnesses and provided records of the dam's history. Iowa DNR did not have an active role in developing the investigation report.

This allowed the investigation team to not only review the failure itself, but to also review the State's dam safety program and regulation of the dam up to the time of failure.

Findings of the panel

The following describes the panel's key findings. Complete findings and recommendations are available in the full IPE report.

Dam design and construction

There was limited information on the dam materials in terms of gradations of the materials and density of the in place embankment. It appears that the dam embankment consisted of a homogeneous material, with a reinforced concrete core wall placed upstream of the centerline of the dam. A sample from the remnant of the embankment was tested and it was determined that the material was a sandy clay with low plasticity (plasticity index of 9).

The concrete core wall was placed on top of steel sheet piling that extended to rock for some distance near the right abutment wall of the gated spillway. The core wall was founded directly on bedrock from the spillway wall to a distance of about 20 feet from the wall. South of that point the sheet piling is shown extending to bedrock for a short distance where the depth to bedrock was known. The top of the cutoff wall extended to within about 6 feet of the crest of the dam.

The concrete cutoff wall on top of a sheet pile wall created a vertically rigid element in the dam that would not settle over time, as compared to the embankment on either side of the cutoff wall which could settle. This situation likely created differential settlement in the area of the cutoff wall that caused low stress that could have lead to cracks in the embankment fill emanating from the top of the cutoff wall. The potential seepage path created by the cracks from the cutoff wall and the low plasticity embankment material created a situation where internal erosion of the embankment could initiate and progress quickly.

The spillway was the primary waterway for passing flood flows at Delhi Dam. The wicket gates in the old power plant have a discharge capacity of about 500 feet3/s but this flow is relatively small compared to the spillway capacity. The spillway is regulated by three 25-foot wide by 17-foot-high vertical lift gates. With all three gates fully opened and the reservoir at elevation 904.8 NGVD29 (130 feet local datum), the estimated spillway capacity is about 32,000 feet3/s.

General Layout of the Delhi Dam and Spillway.

Dam performance prior to flood

No adverse performance of the dam was reported to the IPE. No significant seepage had been reported at the downstream toe or on the downstream face of the dam.

Although the embankment performed well up to the recent event, it is very possible that prior loadings did not achieve a water surface elevation that exceeded the top of the core wall (EL 898.8 ft) or have a sufficient duration to develop internal erosion.

The spillway gates have been difficult to operate in the past. The gate guides are tapered at the bottom and sometimes the gates would stick in the closed or nearly closed position. A crane had been used in previous floods to operate the spillway gates.

The lack of maintenance of the embankment section immediately south of the spillway and the 2H:1V downstream slope made inspection of the dam for seepage flows difficult.

Dam performance during July 22-24 flood

During the July 22-24 flood, Gate 3 could not be opened more than 4.25 feet. This was a significant reduction in the spillway capacity.

Nothing out of the ordinary was observed related to the dam performance during the July 22-24, 2010, flood until the reservoir water surface exceeded the top of the core wall at elevation 898.8 feet. Within about 8 hours of this occurring, vortices in the reservoir and sinkholes on the upper portion of the upstream face of the dam were observed. The first vortex was noticed about 40 to 50 feet south of the concrete structure at 3:30 a.m.; the second, noticed later, was estimated to be about 100 feet south of the concrete structure.

Seepage from the downstream slope was first observed around 6 a.m. July 24, 40 to 50 feet south of the spillway training wall. At 6 a.m., settlement of the dam crest was observed in the areas where the vortices and sinkholes were first observed. All of this evidence is consistent with internal erosion occurring in the portion of the embankment above the top of and downstream of the concrete core wall.

The dam breach began to accelerate around 12:30 p.m. on Saturday, July 24th. The dam breach was caused by internal erosion of the embankment, flows over the embankment and structural failure of the thin concrete core wall.

A full breach of the embankment dam occurred at about 1 p.m. on July 24th. The concrete core wall appeared to have failed due to differential loading caused by the flood and erosion of downstream embankment soils. As erosion of embankment soils continued, sections of the core wall also toppled, eventually ceasing at a maximum breach width of 235 feet. It is likely that the concrete core wall slowed down the rate at which the embankment dam breached.

The breach of Delhi Dam did not cause any loss of life. This is attributed to several factors: the concrete core wall likely slowed down the rate of the dam breach; warning of dam failure was issued several hours before the breach; the flood wave was dissipated in farm fields, which reduced the level of flooding in the downstream communities of Hopkinton and Monticello; and door to door warnings were issued in Hopkinton and Monticello resulting in evacuation of residents whose homes were subsequently inundated.

Alternative scenarios for reservoir operations during flood

A number of scenarios were evaluated to help determine if different spillway operations would have made a difference in reservoir levels and the breach of the dam.

One of the items explored was the effect of the partially closed spillway gate. A routing was performed in which all three gates were opened to 18 feet, which was the maximum opening achieved by Gate 1 during the July 22- 24, 2010 flood.

The flood routing results indicated that Delhi Dam would not have overtopped if all three gates had been fully opened.

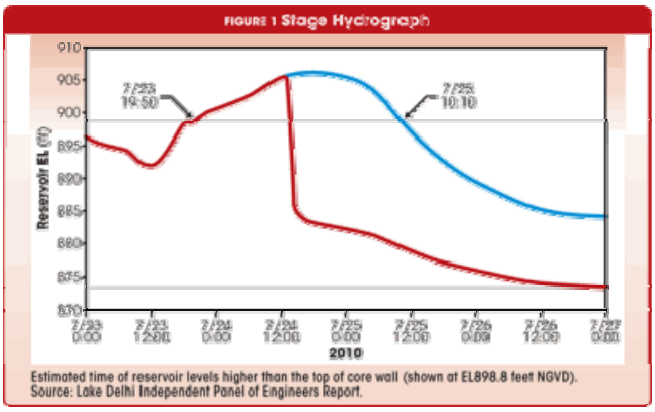
However, the reservoir would have exceeded the top of the core wall by up to 2.4 feet for about a day, and it is likely that internal erosion would have initiated in the embankment.

Based on the duration of seepage that likely would have occurred through the embankment, it is judged that the dam would have suffered damage and possibly a total breach, even with all three gates fully open.

One of the criticisms from downstream residents is that the dam operators should have lowered the reservoir in anticipation of the peak flood inflows.

Routings were performed that evaluated the effect of lowering the reservoir by 2-, 4-, 8- and 10-feet at the beginning of the flood.

The results of these flood routings indicated that the dam would likely have still been overtopped and the reservoir would have exceeded the top of the core wall elevation for an extended period, even with the hypothetical drawdown levels. This reflects the fact that the reservoir volume is relatively small in comparison to the flood volume and any space that was created would have been filled prior to experiencing the peak flood flows.



Estimated time of reservoir levels higher than the top of core wall (shown at EL898.8 feet NGVD).
Source: Lake Delhi Independent Panel of Engineers Report.

Cause of dam breach

From the eyewitness descriptions, photographic and video evidence and limited excavation investigation, the cause of the dam breach was internal erosion in the embankment coupled with overtopping flow.

The internal erosion was most likely caused by a seepage path initiated along differential settlement of the embankment material adjacent to the core wall.

The failure mode was triggered by reservoir levels that exceeded the top elevation of the concrete core wall, which was exacerbated by the inability to open the third gate beyond the 4.25 feet measured in the post breach investigation.

The location and design of the concrete core wall and the fact that it did not extend to the crest of the dam created more favorable conditions for internal erosion of embankment materials once the reservoir reached the elevation corresponding to the top of the core wall.

The IPE believes that any flood of sufficient magnitude to raise the reservoir above the top of the concrete core wall for a more than several hours would have resulted in the embankment experiencing piping/internal erosion.

If internal erosion did not occur, the duration of 16 hours and maximum depth of 1.4 feet of overtopping predicted by the flood model (with one gate malfunctioning) would have likely caused a breach via overtopping and headcutting erosion.

Overtopping erosion to the point of breach was predicted with WINDAM, a NRCS erosion program. A summary of the WINDAM analysis is included in the full IPE Report.

Several other factors that would add to the likelihood of overtopping erosion are the downstream slope of 1V:2H, erosion features located at the toe as described in recent inspection reports, the rock toe and inclusion of the 1920's roadbed, unknown (but likely low) insitu soil densities and the trees and vegetation on the downstream slope.

Conversely, if the dam had not experienced overtopping flows above the original dam crest elevation (this would have required that Gate 3 was fully functional July 22-24, 2010 flood event), it is possible that the internal erosion mechanism by itself would have lead to the breach of the dam.

Recommendations and lessons learned

The scope of the panel's investigation was limited. Several recommendations were made that will add to a better understanding of the breach at Delhi Dam:

- Investigate the remaining sinkhole and the flow path from the sinkhole to its terminus.
- Conduct a complete investigation of the remnant of the embankment, 1967 berm and foundation soils including but not limited to classification of soil and critical material properties.

The IPE also made recommendations that address issues related to managing dam safety issues and a dam safety program:

- More consistent approaches should be developed for classifying dams according to hazard and achieving compliance with the associated design standards. The DNR classified Delhi Dam as moderate hazard, but Ashton Engineering classified the dam as low hazard. This has an impact on the design flood standard that is applied to dams.
- Dam inspectors performing inspections for the DNR and consulting engineering firms performing dam safety evaluations should have strong backgrounds in dam engineering and potential failure modes analysis. There were design weaknesses at Delhi Dam that an experienced dam engineer should have recognized, which likely would have led to additional investigations.
- The failure of Gate 3 to fully operate during the flood appears to have been caused by the failure to complete concrete repairs behind the left gate guide. Education and enforcement mechanisms are needed to clearly identify critical dam safety issues and their impacts and to ensure these issues are resolved quickly.
- Review/update the estimated return period for the July 2010 flood event based on historical inflows at Delhi Dam.

What's next?

The Lake Delhi Recreation Association is currently planning to reconstruct the dam and potentially restore hydroelectric power generation.

The funding source for this rebuilding effort is still unknown. The LDRA is beginning the process of a full engi-

neering study to determine alternatives for dam reconstruction.

The Iowa DNR dam safety program continues to improve its program with dam owner outreach and additional staff for breach evaluation and mapping.

ASDSO has recently formed a committee to evaluate failure investigations of Delhi Dam and other dams which have failed with the goal of improving the current practice of investigating dam failures.

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RCC Dam Design: Analyzing Stress and Stability

Ernest K. Schrader

The author — who has been involved in the design and construction of more than 100 RCC dams in 35 countries — shares recommendations on how best to conduct stress and stability analyses when designing an RCC dam.

One important area of consideration in designing an RCC dam is stress and stability analysis. This involves including provisions for proper control for thermal stresses. Without proper thermal control, cracking can occur that leads to unacceptable leakage and potential for failure by sliding or overturning. Properly performing stress and stability analyses for a variety of situations and dam sections is critical to the design of any dam, including RCC. By using the proper methods and evaluating the relevant parameters, designers can ensure an RCC dam will provide adequate safety and stability under all foreseeable conditions.

Temperature studies and thermal control

Because thermal volume changes in concrete can lead to increased stresses or cracking, the design of any concrete dam (whether conventional concrete or RCC) should include provisions for dealing with the inherent temperature changes and resulting volume changes of any concrete mass. The principal concerns related to cracking in RCC and other concrete gravity dams are stability of the structure, appearance, durability, and leakage control. Although it is not usually a critical factor in structural stability, uncontrolled leakage through transverse cracks in a concrete dam can result in an undesirable loss of water from the reservoir, create operational and/or maintenance problems, and be visually undesirable. Leakage can be extremely difficult to control.

Typically, thermal stresses and associated volume changes result in transverse cracking of the concrete structure. However, RCC dams experiencing high thermal stresses also may exhibit unseen cracking parallel to the axis of the dam. This type of cracking has occurred in both conventional concrete and RCC dams and can have serious implications with regard to structure and stability. A dam with this type of cracking probably will be safe and stable for normal load conditions if the crack is closed and does not contain water, although with reduced factors of safety. However, experience has shown that this type of cracking can jeopardize sliding and overturning stability if the crack opens and fills with water. The source of water can be the foundation, seepage through lift joints, monolith joints with failed waterstops, or transverse cracks.

When attempting to predict the degree of cracking a structure may experience, a number of factors should be evaluated. Simple analyses that combine very generalized conditions yield very general results. Complex analyses combine very specific determination of conditions to yield more exacting results. At a minimum, dam designers should consider daily and monthly ambient temperature fluctuations, the conditions during construction for aggregate production and RCC mixing that lead to the temperature range at which RCC will be placed, a realistic placing schedule, and realistic material properties. In many cases, the results of a thermal study are key to determining mixture proportions, construction schedule, and cooling and jointing requirements.

More so than for conventional concrete dams, comprehensive, state-of-the-art analyses that account for the time-dependent effects of temperature — including adiabatic heat rise, ambient climatic conditions, simulated construction operations, and time variant material properties — are necessary to properly analyze thermal issues in RCC dams. This is partly because each RCC lift is relatively thin (usually 1 foot), with a small mass compared to the exposed surface area. By contrast, conventional mass concrete typically is placed in thick lifts (usually 5 feet), with a large mass compared to the exposed surface area. Also, RCC material properties typically are much more dependant on maturity and load than conventional concrete. As a result, RCC thermal analyses typically require more detail. Various analytical methods, ranging from hand computations to more sophisticated finite element methods (FEM), are available to provide an estimate of the temperature and thermal stress or strain distributions throughout a structure. The U.S. Army Corps of Engineers and others have published information on temperature evaluations unique to RCC.[1,2]

Placing concrete at night is one effective way to minimize thermal stresses during construction of a roller-compacted-concrete dam.

Specific actions can be effective in minimizing thermal stresses in RCC dams. These include substituting pozzolan for some of the cement, limiting RCC placement to cool weather, placing RCC at night, lowering the placing temperature, and providing appropriate formed jointing. When the option is available, selecting an aggregate of low elastic modulus and low coefficient of thermal expansion also is helpful. The American Concrete Institute, in a 2007 report, discusses cooling options that have been effective for RCC.[3]

The exposure of relatively thin lifts of RCC during initial hydration may contribute to an increase or decrease in peak temperatures, depending on ambient conditions and the length of exposure. Each situation must be separately and carefully evaluated. For example:

- While placing RCC during a hot time period, the surface of the concrete absorbs heat from the sun. This increases the temperature of the mixture at a rate that may be greater than the rate at which heat from internal hydration is generated. The longer the surface is exposed, the more solar energy is absorbed, which can produce a higher peak internal temperature. Faster placement in this situation will help reduce internal temperatures.

- With RCC placement during cooler times of the year, the large exposed RCC lift surface loses heat to the atmosphere. Also, materials going into the mix, as well as the mix itself on the way to the placement, are naturally precooled. This results in lower placing temperatures and, consequently, lower peak temperatures. If the time interval until placement of the next lift is long, some of the early heat from hydration can be dissipated to the atmosphere. But if the peak temperature does not occur before placement of the next lift, faster placing can reduce the beneficial effect of losing heat to the atmosphere.

Methods for stress and stability analysis

Approaches to stress and stability analysis for RCC dams are similar to those used for conventional concrete structures. However, for RCC, there is added emphasis on tensile strength and shear properties of the horizontal lift joints, and on non-linear stress-strain behavior.

With regard to horizontal lift joints, some RCC dams have lift joints with cross slope or "dip" of 5 degrees or more, to facilitate surface drainage during construction. The effect of this dip on stability does exist but is minimal. It effectively adds or subtracts about 1 or 2 degrees from the coefficient of friction for the lift surface, depending on whether the lift surface slopes upward (positive benefit) or downward (negative effect) when going from the upstream to downstream face. Technically, it is better to have a slight upward slope from upstream to downstream. However, some practitioners find that a horizontal cross slope is much easier to construct, so they prefer no slope, while other practitioners have found the cross slope to be beneficial for clean-up and surface drainage, without any real effect on constructability.

During initial design of an RCC dam, designers perform static stress analysis. For dams in wide canyons, or with contraction joints that will be open, a two-dimensional gravity or FEM analysis is adequate to calculate stresses.

More complex methods of analysis — such as the trial-load twist method or three-dimensional FEM — have been used. These are mostly applied for large dams, dams with high earthquake loadings, and dams located in narrow "V" canyons where even a straight axis orientation can have three-dimensional benefits with reduced stresses and improved stability.

For dams in seismically active areas, a dynamic stability analysis is necessary using a two- or three-dimensional FEM, whichever is appropriate for the site conditions and canyon shape. Special attention must be given to considering whether the monolith joints will be open or closed. The monolith joints will tend to open due to thermal contraction, with more opening for wider joint spacings and greater thermal gradients. However, the joints will tend to typically be tighter at the foundation and wider higher up in the dam. They also can close due to three-dimensional effects from a curved axis or a straight axis dam in a narrow "V" canyon. Closed joints will impart more three-dimensional benefits, whereas open joints cannot easily transfer these three-dimensional effects from one monolith to the other.

Unless there is site-specific justification, recommended safety factors to be applied for the complete range of loading conditions for RCC dams should be the same as for conventional concrete dams.

Shear-friction factor

For the purposes of this discussion, the focus will be on shear within an RCC dam. Foundation shear and stability should be evaluated as a related but separate issue.[4,5]

As with a conventional concrete gravity section, resistance to sliding within an RCC section depends on cohesion, the confining stress on the potential failure plane, and the coefficient of sliding friction along the failure plane. In addition to sliding or shear along lift joints, shear through the mass (crossing lift joints) also should be considered, especially if there are thinned sections in the mass, such as at an extended toe. However, the typical controlling shear plane will be along the weakest lift joint relative to applied sliding force, as it is for conventional concrete dams. However, RCC has many more lift surfaces than traditionally placed mass concrete, and RCC is more likely to have lower cohesion at the lift surface than traditionally placed internally vibrated concrete (IVC) (especially with leaner mixes and with excessive lift joint maturity). Thus, the probability of at least some weak lift surfaces can be greater with RCC than with IVC. This is minimized through proper mix designs, construction equipment and procedures, concrete set retarding admixture, and diligent inspection.

Fortunately, the friction component of shear resistance along lift surfaces is essentially unaffected by the type of mix, maturity, and marginal construction. However, the cohesion component of sliding shear resistance along lift joints is very sensitive to: content and quality of cementitious materials; construction means, methods, and quality; and lift joint maturity, including initial set time of the mix.

The classic structural design parameter of the shear-friction factor (SFF) is a measure of a dam's stability against sliding. The SFF on any horizontal plane in the dam is the same for RCC as it is for conventionally placed IVC. That is:

Equation 1:

$$SFF = (cA + (N - U) \tan w)/T$$

where:

c is unit cohesion;
A is the area of cross section;
N is the component of confining force normal to the sliding surface;
U is the uplift force acting on the cross section;
w is the angle of sliding friction; and
T is the driving force parallel to the sliding surface.

Most design criteria require a minimum SFF of safety against sliding of 2 to 4, based on normal high headwater and low tailwater conditions. This can drop to 1.5 to 2 under flood conditions, and typically is defined as greater than 1 for seismic loads. Although it is not considered by most codes and authorities, a true "fail safe" criterion for stability of an RCC dam is that the SFF of safety against sliding is greater than 1 for all load conditions, using a cohesion value of zero and a realistic residual friction angle after sliding, with realistic uplift for debonded lift joints. Precedents exist for this very conservative design approach. The most notable is the design of the new Saluda Dam on the Saluda River in South Carolina, United States.[6]

Shear properties at lift surfaces depend on a number of factors, including mixture properties, joint preparation, elapsed time from mixing to compaction, and lift exposure conditions (lift joint maturity). Actual values used in final designs should be based on tests of the materials to be used or estimated from tests on RCC mixtures from other projects with similar aggregates, cementitious material content, aggregate gradations, and joint preparation. As with any dam design, the designer of RCC structures should be confident that design assumptions are realistically achievable with the anticipated construction conditions and available materials.

For initial planning purposes, a conservative value of lift joint cohesion of 5 percent of the design compressive strength with a coefficient of friction of 1 (corresponding to a w friction angle of 45 degrees) is generally used. This should be adjusted as site-specific mixes and material properties are better evaluated. Cohesion tends to be slightly lower for dry consistency RCC mixes and slightly higher for wetter consistency mixes. Where bedding mix is used, the cohesion value will be essentially the same as that value of the unjointed RCC mass, which typically is weaker than the bedding. This normally approximates at least 10 percent of the compressive strength of the unjointed RCC.

Determining design values for shear

Design values for shear strength at lift joints can be determined in several ways. Drilled cores can be removed from RCC test placements and tested in shear and direct tension, but this is difficult, costly, and time-consuming. Drilling at an angle minimizes lift joint de-bonding and damage, but makes direct shear testing of the sample more complicated. If cores are drilled at two different angles steeper than the friction angle, the cores can be tested in a compression machine to determine the actual friction angle and cohesion.

Individual specimens can be fabricated in the laboratory with simulated lift joints if the mixture is of a consistency and the aggregate is of a size that permits fabrication of representative individual samples. It is imperative that these specimens represent the true full-scale conditions. Care is needed to realistically correlate laboratory-prepared samples to what will be achieved in the field.

At many RCC dams, realistic lift joint shear tests have been performed by using a series of large blocks of the total RCC mixture cut from test placements compacted with full-scale equipment or walk-behind rollers that simulate the energy of a large roller.[6,7] Various lift joint maturities and surface conditions of the actual mixture for the project are evaluated and used to confirm or modify the design and construction controls. For example, a comprehensive series of tests was performed for Saluda Dam, where the design was based on residual shear strength after sliding.[6]

In-situ direct shear tests also have been performed at various confining loads on blocks cut into field placements made with full production equipment and procedures. They also can be done by shearing blocks at saw cuts made into an RCC gallery floor.

In all cases, shear testing of RCC is delicate and unique. Testing requires experienced personnel, special equipment, and special procedures. *In-situ* tests are probably the most difficult, requiring extra care and attention to details.

Shear property estimates and shear analyses should take into account several key factors, including:

- It is not reasonable that an isolated section of an RCC dam would slide away, leaving behind another portion of the dam that remains bonded at a lift joint. Consequently, over-reaction should be avoided if a FEM analysis indicates that shear stress exceeds shear strength (with the appropriate factor of safety) for a small portion of a large lift surface;

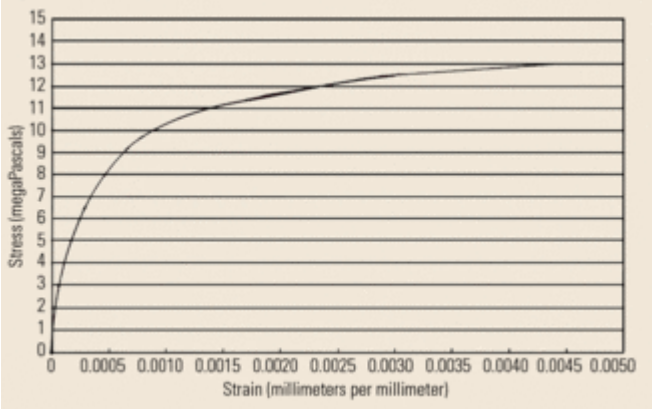
- Estimated shear strengths should include appropriate consideration for the reasonable amount of debonded area to be expected on lift joints;

- When a "back-analysis" is done using results of cores or shear blocks extracted from a dam, the percent of debonded lift joints should be considered. A debonded lift joint typically will have the same friction as bonded joints, but it has no cohesion or tensile capacity. After excluding cores that were broken by mechanical forces of coring or handling, the remainder of debonded cores should be assigned a cohesion value of "zero" when the average cohesion is calculated; and

- One unacceptable lift joint is all that is required for failure. It is inappropriate to average good values from adjacent lifts with bad values from a clearly identifiable bad lift joint.

Non-linear stress-strain behavior

RCC mixtures, especially those with low cementitious contents, tend to havenon-linear stress-strain behavior with strain softening (see Figure 1). That is, at increasing stress levels the material deforms or strains more than it does for the same unit increase in stress at a lower stress level. Strain softening occurs similarly in both tension and compression. This can have the beneficial effect of decreasing peak stresses that otherwise would occur in isolated areas such as the toe or heel of a high dam, and at other stress concentrations that usually are related to earthquakes. As deformation in the area of high stress increases with increasing load, very little added stress occurs. Instead, most of the stress that would have been added to this area if the concrete had linear elastic properties is re-distributed to adjacent areas of lower stress.



Roller-compacted concrete exhibits a specific type of stress-strain behavior. At higher levels of stress, the rate of increase becomes slower for every increment of increasing strain (or deformation). This behavior results in less stress for increasing deformation, as well as in a redistribution of stress to areas of lower stress within the mass.

Examples of this situation include reductions in peak stress for the non-linear properties of RCC at Mujib Dam on the Mujib River in Jordan.[8] This dam was completed in 2003, primarily to impound water for irrigation.

Uplift and upstream watertightness

Proper estimates of uplift within the dam are essential, regardless of whether it is constructed with conventional concrete or RCC. Recent practice and industry guidelines have established that the designer should evaluate imperviousness at the upstream face based on precedent, trial sections, and experience for the method being used to establish the expected degree of watertightness and uplift control on each project.[9] This is a change from the past practice of assuming 100 percent uplift at the upstream face and 67 percent reduction of uplift at the drilled drains. If the procedure to be used to estimate uplift (with the anticipated degree of quality control) demonstrates that uplift will be less than 100 percent near the upstream face, it may be appropriate to use this reduced uplift in the stress and stability analysis.

As an example, consider a dam design with a proper impervious upstream watertight barrier with face drains. When this type of system is properly designed and installed, it allows total control of uplift pressures at the upstream face. A conservative approach initially was taken in the design of earlier RCC dams using this system, by applying 50 percent uplift reduction at the upstream face, with 67 percent additional reduction at drilled internal drains within the mass of the RCC. This results in significant improvements in stability and reduction of heel stresses.[8]

However, experience and performance of this type of system (an impervious upstream membrane or facing used in conjunction with a drain between the facing and RCC to relieve any pressure that may migrate past the facing) has shown reliable 100 percent reduction of uplift at the upstream membrane when properly designed and constructed. Thus, the 50 percent reduction of uplift at the face is overly conservative.

Many RCC dams are constructed with stair-stepped spillways, using formed RCC, grout-enriched RCC, or conventional IVC for the steps. The horizontal lift joint surface between steps is typically not watertight. Any lift joint seepage that migrates to the downstream face normally can escape along the lift joint. In some cases, drains have been installed through the steps to assure that uplift pressure can escape. If the pressure cannot escape — for example, if a continuous slab of concrete is used to create a smooth conventional spillway over the RCC — uplift is trapped on the RCC lift joint behind the slab. The design should address the implications of this potential increased uplift both within the mass and against the spillway slab, or drainage should be provided under the slab.

Tensile strengths

Low-cementitious-content RCC with drier consistency typically has low, but adequate, lift joint tensile strength in most of the dam with no special joint treatment. Although it varies from dam to dam, with lift joint maturity, and with the degree of inspection, the overall long-term average lift joint strength for these types of mixes tends to be about 30 to 80 percent of the unjointed RCC tensile strength. Lower percentages are applicable to leaner mixes, older lift joint maturities, shorter set times, and more damage or contamination at the lift surface. Higher percentages are applicable to higher cementitious content mixes, younger lift joint maturities, longer set times, and better-quality lift surfaces. When bedding mix (mortar or concrete) is used between lift joints, the lift joint typically will achieve 100 percent of the tensile strength of the unjointed RCC.

Drains (see arrow) installed through the steps of stair-stepped spillways provide an outlet for escape of uplift pressure in roller-compacted-concrete dams.

Lift joint bonding is of interest from the perspectives of tensile strength (usually under earthquake load), cohesion for sliding resistance, and watertightness. Static strengths are discussed below. Tests of various concrete mixes have shown that the dynamic or fast-loading strength applicable to earthquakes is higher, with the dynamic increase factor (DIF) being greater for faster loads and for lower strength concrete and lower for slower loads and higher strength concrete. Without site-specific test data, RCC typically is assumed to have a DIF of 150 percent of the static tensile strength. Interestingly, tests of lower-strength concretes show the DIF to be higher than for higher-strength concretes. Tests also have shown that the DIF increases dramatically at very rapid rates of loading.

Additional considerations for lift joints

RCC mixtures that exhibit bleeding of mix water contain more water than is necessary for optimum performance. Water contents should not extend into this range. Eliminating the occurrence of bleed water in the mix is one of the purposes of trial mixing during the design phase (recommended) or just prior to construction. The water content of the mixture depends on the characteristics of the materials being used, primarily the quality of the aggregate fines and pozzolanic materials. Bleed water can deposit laitance on the surface of the RCC lift. In sufficient quantity, laitance can seriously degrade the shear performance of the lift. Where bleeding occurs in mixtures with high cementitious contents, an increase in laitance deposition is possible. This should be avoided.

One example of such a phenomenon is during recent evaluations of density, compaction, and lift joint quality at Saluda Dam. The test section lift joints showed the *appearance* of good bond with wetter consistency RCC containing 125 to 175 pounds of cement per cubic yard, plus a similar amount of fly ash, no retarder, and no forced cooling (but placed in generally mild conditions). Visual examination of saw cuts through the cross section of mass placements indicated excellent bond with good contact between lifts. However, when one set of saw cut blocks was removed for testing, the blocks debonded where there was just slight evidence of laitance. This occurred at the surface of mixtures with lower VeBe times and mixes that tended to bleed. No other test blocks separated at the lift.

To achieve shear properties approaching that of parent concrete, it is critical that lifts be placed before the "initial set" of the underlying lift. Highly workable RCC containing high proportions of cementitious materials can achieve high shear performance without supplemental bedding mortar only if placement is done on surfaces that have not yet set. Many factors contribute to the setting characteristics of RCC surfaces. Examples include the chemical composition of the cement, fineness of the cement, amount of pozzolan that is used, temperature of the mix when it is placed, ambient temperature, effectiveness of moist cure prior to placing the next layer of RCC, and effectiveness and quantity of any admixtures.

Dr. Schrader may be reached at Schrader Consulting, 1474 Blue Creek Road, Walla Walla, WA 99362 USA; (1) 509-529-1210; E-mail: eschrader@columbiaenergyllc.com.

Ernie Schrader, PhD, P.E., is a consultant with more than 30 years of experience in roller-compacted concrete (RCC). He has been involved in more than 30 RCC dams that are complete and operational, several under construction, and many undergoing design and feasibility studies. The projects range from the world's highest and largest to the smallest RCC dams.

Notes

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(HydroWorld weekly, 19 July 2011)

Φωτογραφίες από το φράγμα Cingino στην Ιταλία

Κοιτάζοντας, όμως, κοντύτερα …

Πρόκειται για ίβικες (Ίβηξ : αλπικός αίγαγρος, συγγενής του κρητικού κρι-κρι), που τους αρέσει να τρώνε βρύα, λειχήνες και να γλείφουν το αλάτι από την επιφάνεια του φράγματος.

ΠΡΟΚΥΡΗΞΕΙΣ ΒΡΑΒΕΙΩΝ ΚΑΙ ΔΙΑΓΩΝΙΣΜΩΝ ΓΙΑ ΓΕΩΤΕΧΝΙΚΟΥΣ ΜΗΧΑΝΙΚΟΥΣ

Χορέψτε με το...διδακτορικό σας

Διεθνής διαγωνισμός-πρόκληση για νέους ερευνητές.

Η επιστήμη φαντάζει βαρετή στα μάτια πολλών ανθρώπων, ενώ μερικές φορές ένας κάτοχος διδακτορικού τίτλου δεν μπορεί να εξηγήσει σχεδόν σε κανένα γύρω του τι, στο καλό, είναι αυτό με το οποίο ασχολήθηκε. Για να βελτιώσει τα πράγματα, ένα από τα κορυφαία επιστημονικά περιοδικά στον κόσμο, το "Science", υποστηρίζει ένα πρωτότυπο διεθνή διαγωνισμό με τίτλο «Χορέψτε το διδακτορικό σας», με σκοπό να δώσει σε κάθε νεαρό ερευνητή και μελλοντικό επιστήμονα την ευκαιρία να εξηγήσει το θέμα των σπουδών του σε συγγενείς και φίλους μέσα από μια πιο οικεία «γλώσσα», αυτή του χορού!

Στο διαγωνισμό «Dance Your Ph.D», που γίνεται φέτος για πέμπτη φορά, μπορεί να συμμετέχει κάθε κάτοχος διδακτορικού ή όποιος ήδη εργάζεται για να αποκτήσει ένα τέτοιο ανώτατο τίτλο, σε οποιοδήποτε πεδίο της θετικής επιστήμης, από οποιαδήποτε χώρα. Αρκεί όποιος συμμετέχει να έχει τη διάθεση -και την ικανότητα- να χορέψει με τέτοιο τρόπο που οι κινήσεις του να αντανακλούν την ουσία του επιστημονικού έργου του και, παράλληλα, να έχουν μια δική τους αισθητική αξία.

Οι ενδιαφερόμενοι μπορούν να εμπνευστούν από τη δουλειά των περυσινών φιναλίστ στη διεύθυνση http://news.sciencemag.org/sciencenow/2010/09/dance-your-phd-finalists-announce.html και μετά να υποβάλουν online, μέχρι τις 10 Οκτωβρίου, ένα βίντεο δικής τους δημιουργίας στη διεύθυνση http://gonzolabs.org/dance/. Ο κάτοχος ή φοιτητής διδακτορικού μπορεί να χορεύει μόνος του ή με παρέα (αλλά ο ίδιος δεν μπορεί να κάνει απλώς την χορογραφία και μετά να μην χορέψει…).

Οι φιναλίστ σε κάθε μια από τις τέσσερις επιστημονικές κατηγορίες (φυσική, χημεία, βιολογία, κοινωνικές επιστήμες) θα κερδίσουν από 500 δολάρια, ενώ ο τελικός μεγάλος νικητής θα πάρει άλλα 500 δολάρια. Επιπλέον, θα ταξιδέψει, με όλα τα έξοδα πληρωμένα, στις Βρυξέλλες για να παρακολουθήσει τη διεθνούς φήμης παγκόσμια εκδήλωση καινοτομίας TEDxBrussels, που θα πραγματοποιηθεί στις 22 Νοεμβρίου στη βελγική πρωτεύουσα.

(www.kathimerini.gr, 31.08.2011 με πληροφορίες από ΑΠΕ-ΜΠΕ)

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

XIV Panamerican Conference on Soil Mechanics and Geotechnical Engineering (October) & V PanAmerican Conference on Learning and Teaching of Geotechnical Engineering & 64th Canadian Geotechnical Conference, Toronto, Ontario, Canada, 2 - 6 October 2011, www.panam-cgc2011.ca

SARDINIA 2011, Thirteenth International Waste Management and Landfill Symposium, 3 - 7 October 2011, S. Margherita di Pula, Cagliari, Italy, www.sardiniasymposium.it/sardinia2011

The Second World Landslide Forum, "Putting Science into Practice", 3 – 9 October 2011, FAO Headquarters, Rome, www.wlf2.org

Technical Meeting TC207 "Soil-structure Interaction and Retaining Walls", October 5-8, 2011, Dubrovnik, Croatia, www.georec.spb.ru/tc207/2011-Croatia

4th Japan – Greece Workshop "Seismic Design of Foundations, Innovations in Seismic Design, and Protection of Cultural Heritage", October 6 (Thu) – 7 (Fri), 2011, Kobe, Japan, www.civil.tohoku-gakuin.ac.jp/yoshida/4JGW

International Conference on Geotechnics for Sustainable Development GEOTEC HANOI 2011, 6 - 7 October 2011, Hanoi, Vietnam, www.geotechn2011.vn

Landslides and Geo-Environment, Geotechnical Symposium in Balkan Region, October 2011, Tirana, Albania, fatos.cenalia@gmail.com, erjon.bukaci@gmail.com

60th Geomechanics Colloquy, October 13th and 14th, 2011, Salzburg, Austria, www.oegg.at/index.php?id=20&L=2

IBSBI 2011 International Conference on Bridges and Soil-Bridge Interaction, 13-15 October 2011, Athens, Greece, http://ibsbi2011.ntua.gr

Η συμβολή της Τεχνικής Γεωλογίας στα έργα ανάπτυξης και υποδομής στη Βόρειο Ελλάδα

Σας γνωστοποιούμε ότι η Ελληνική Επιτροπή Τεχνικής Γεωλογίας (ΕΕΤΓ), της Ελληνικής Γεωλογικής Εταιρείας (Ε-ΓΕ), που υπάγεται στη Διεθνή Ένωση Τεχνικής Γεωλογίας και Περιβάλλοντος (IAEG), προτίθεται στο πλαίσιο των διετών ημερίδων που πραγματοποιεί και σε συνδυασμό με τον εορτασμό των 60 χρόνων της ΕΓΕ, να υλοποιήσει την επόμενη ημερίδα της στην πόλη της Θεσσαλονίκης, υπό την αιγίδα του κ. Υφυπουργού Υποδομών, Μεταφορών και Δικτύων.

Αντικείμενο της ημερίδας, που θα πραγματοποιηθεί στο Αμφιθέατρο «Βασίλειος Κυριαζόπουλος» (Μετεωροσκοπείο) του Γεωλογικού Τμήματος του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης την Παρασκευή 14η Οκτωβρίου του 2011, είναι: *"Η συμβολή της Τεχνικής Γεωλογίας στα έργα ανάπτυξης και υποδομής στη Βόρειο Ελλάδα"*, σκοπό δε έχει την ενημέρωση των συναδέλφων γεωλόγων αλλά και των μηχανικών στη Βόρεια Ελλάδα αναφορικά με τις εξελίξεις των αντικειμένων της τεχνικής γεωλογίας αλλά και την ανταλλαγή απόψεων.

Σε αυτή θα συμμετέχουν με παρουσιάσεις Φορείς (όπως η ΔΕΗ Α.Ε., το ΙΓΜΕ, το Αττικό Μετρό, η Εγνατία Οδός Α.Ε, το ΙΤΣΑΚ και η ΔΕΗ ΑΝΑΝΕΩΣΙΜΕΣ), Πανεπιστήμια (Γεωλογικό Τμήμα Αριστοτέλειου και Πολυτεχνική Σχολή Δημοκρίτειου), Μελετητές (εκπρόσωποι του Συλλόγου Γεωλόγων Μελετητών Ελλάδας, GEODATA, ΓΕΩΓΝΩΣΗ), καθώς και Τεχνικές Εταιρείες (Ελληνικός Χρυσός Α.Ε. και Κοινοπραξία κατασκευής των έργων του Μετρό Θεσσαλονίκης). Επίσης, θα τιμηθεί ο Αν. Καθ. ΕΜΠ Δ. Ρόζος για τη συμβολή του στην ανάπτυξη της Τεχνικής Γεωλογίας. Σας προσκαλούμε για την παρακολούθηση της ημερίδας.

2nd ISRM International Young Scholars' Symposium on Rock Mechanics, Beijing, China, October 14-16, 2011, www.isrm2011.com

Beijing 2011, 12th International Congress on Rock Mechanics – Harmonizing Rock Mechanics and the Environment, 16 – 21 October 2011, Beijing, China, www.isrm2011.com

HYDRO 2011 "Practical Solutions for a Sustainable Future", Prague, Czech Republic, 17-19 October 2011, www.hydropower-dams.com

2011 AFTES Congress "Espaces Souterrains de Demain", Lyon, France, 17 – 19 October 2011, www.aftes.asso.fr/congres_presentation-organisation.html

International Conference on Deep Foundations and Problems of Underground Space Development, 18 - 19 October 2011, Perm – Ufa, Russia, Contact: spstf@pstu.ac.ru

LANDFILL 2011 Waste Management Facilities – The New Order, 18 - 20 October 2011, Durban, South Africa. Conference Chairman: JohnPa@dmws.durban.gov.za

XI INTERNATIONAL CONFERENCE UNDERGROUND INFRASTRUCTURE OF URBAN AREAS, 26-27 October 2011 Wroclaw – Poland, www.uiua2011.pwr.wroc.pl

WCCE-ECCE-TCCE Joint Conference 2 SEISMIC PROTECTION OF CULTURAL HERITAGE, October 31 - November 1, 2011 Antalya, Turkey, www.imo.org.tr/spch

3Ο ΠΑΝΕΛΛΗΝΙΟ ΣΥΝΕΔΡΙΟ ΟΔΟΠΟΙΙΑΣ Νοέμβριος 2011, Πάτρα, http://portal.tee.gr/portal/page/portal/INTER_RELATIONS/INT_REL_P/SYNEDRIA_EKDHLWSEIS/2011/3odopoiias

TAILINGS AND MINE WASTE 2011
November 6-9, 2011, Vancouver, Canada
www.tailingsandminewaste2011.org

The Conference objective is to provide a forum for presenting the state of the art with respect to mill tailings and mine waste, and to discuss current and future issues facing the mining and environmental communities.

Tailings and Mine Waste '11 is part of a series of symposia on mill tailings management started at Colorado State University in 1978. The primary purpose of the Conference is to provide a forum for members of the mining community, engineers and scientists serving the mining industry, regulatory groups, and other interest groups concerned with environmental issues related to tailings and mine waste management. Issues of environmental science and engineering, geochemistry, geotechnics, hydrogeology, milling, mining, mining engineering, tailings management, and other topics related to tailings and mine waste will be covered in focused sessions.

The program will include sessions by practitioners and recognized experts on the general themes of the Conference. The Conference also will include exhibits of equipment and instrumentation and short courses. Proceedings of the Conference will be published and available at the time of the event. Authors of all papers included in the Proceedings will be allowed to make oral presentations at the Conference.

Conference Themes:

- Tailings
- Waste rock, ore and other mined materials
- Containment systems
- Contaminated controls
- Permitting
- Water management
- Life cycle management, sustainability, green engineering, etc.

For additional information and sponsorship inquires, please contact the Conference Secretariat, InfoMine at the coordinates below. Please ask for either Shahzia Noorally (ext. 262) or Zoe Mullard (ext. 296).

InfoMine Inc.
Suite 900, 580 Hornby Street Vancouver, BC Canada V6C 3B6
Tel: +1 604 683 2037 Email: tmw2011@infomine.com

ICAGE 2011 International Conference on Advances in Geotechnical Engineering, 7th - 9th November, 2011 - Perth, Australia, http://www.icage2011.com.au

ITA COSUF Workshop and AG-meetings
Amsterdam and Amersfoort, The Netherlands
14-15 November 2011

ITA COSUF Workshop and AG-meetings in Amsterdam and Amersfoort in The Netherlands - 14-15 November 2011 hosted by Arcadis and Efectis.

The workshop will include a technical visit to the Amsterdam metro, including the new North-South Line.

The provisional programme is as follows:

Monday 14 November afternoon: Workshop with presentations and technical visit in Amsterdam, including the Central Railway Station
Monday 14 November evening: joint dinner in Amersfoort
Tuesday 15 November morning: AG-meetings in Amersfoort

CONTACT & ORGANISATION:
ITA-COSUF c/o EPFL – Bât. GC – Station 18, CH-1015 Lausanne, Switzerland
Fax: +41 21 693 41 53, Tel: +41 21 693 23 10
Email: secretariat(at)ita-aites.org

AP-UNSAT 2011 5th Asia-Pacific Conference on Unsaturated Soils, 14 - 16 November 2011, Pattaya, Thailand www.unsat.eng.ku.ac.th

SI11 9th International Conference on Shock & Impact Loads on Structures, 16 – 18 November 2011, Fukuoka, Japan, www.cipremier.com

GEOMAT 2011 First International Conference on Geotechnique, Construction Materials and Environment, Tsu City, Mie, Japan, November 21-23, 2011, http://gipremi.webs.com

2011 ICKGSS International Conference on Sustainable Application of Geosynthetics Technology Commemoration of 10th Anniversary of Korean Geosynthetics Society Foundation, 23 - 24 November 2011, Seoul, South Korea, Contact: hyjeon@inha.ac.kr

Geotechnical Engineering Conferences of Torino (XXIII Edition)
EARTH RETAINING STRUCTURES AND SLOPE STABILIZATION: THEORY, DESIGN AND APPLICATIONS
23-24 November 2011, Torino, Italy
www.cgttorino.org

Retaining structures, with particular reference to the systems for slope stabilization, can be considered among the most delicate and difficult geotechnical engineering applications. Role of pore fluids in static and dynamic conditions, soil-structure interaction, displacements of retaining structures and nearby buildings, admissible displacement design method in seismic conditions, are some of the issues currently discussed and debated in the geotechnical community, also accounting for the recent Italian construction regulations (NTC 2008) and their interpretation.

On the basis of the most advanced theoretical and experimental state of the art, this CGT edition is aimed at answering the main questions which the geotechnical designer has to face.

The first session of the Conference program deals with the theoretical issues concerning the evaluation of earth and pore fluid pressure, under static, dynamic, drained and undrained conditions.

The following sessions are devoted to applicative topics. Design methods for gravity walls, diaphragms, reinforced earth retaining structures and soil nailing are illustrated.

A specific session is focused on slope stabilization, including applicative examples relative to landfills. The new technologies are the topic of the last session, which deals with diaphragms, secant pile walls, anchors and drainage systems.

Therefore, the Conference program provides a complete and updated picture of the advances in the design and construction technologies of earth retaining structures and slope stabilization methods from both theoretical and applicative point of view.

Organizing Secretariat

AXEA Conferences and Events
Via Caboto, 44
10129 Torino - Italy
Tel. (+39) 011.599.498 (+39) 011.591.871
Fax 011.590.833
e-mail: info@cgttorino.org, www.axeacongress.com

EUCEET Association Conference "New trends and challenges in civil engieering education", November 24-25, 2011, Patras, Greece, www.euceet.upatras.gr

Piling & Deep Foundations Australasia
28 - 30 November, 2011, Brisbane, Australia
http://www.pilingtechniques.com.au/Event.aspx?id=482914&MAC=CE

The Piling and Deep Foundations Australasiaconference is an exclusive event that will discuss the latest challenges, opportunities and solutions to optimise site investigation to select, design and insert the best pile type for your projects. Uniting the leading experts from piling contractors, geotechnical engineers, structural engineers, asset owners, pile driving equipment providers, solution providers and service providers, you will gain the opportunity to network and discover how they are currently innovating and shaping the future of piling and deep foundations within Australasia.

Main focus :

- Designing, testing and implementing sustainable piling & deep foundations that will ensure the infallible integrity for the life of the structure
- Designing cost effective means for constructing deep foundations
- Improving the safety of deep foundations in difficult geotechnical conditions
- Overcoming base resistance through innovative testing systems
- Solving piling problems during the construction phase
- Educating all stakeholders involved in construction projects the importance of piling and deep foundations
- Interact with target business partners within the networking sessions
- Key national and international piling case studies

International Symposium on Advances in Ground Technology and Geo-Information (IS-AGTG), 1-2 December 2011, Singapore, www.is-agtg.com

SGCC2011 International Symposium on Sustainable Geo-syn-thetics and Green Technology for Climate Change (Retirement Symposium for Prof. Dennes T. Bergado), 7 to 8 December 2011, Bangkok, Thailand, www.set.ait.ac.th/acsig/sgcc2011

XTH Regional Rock Mechanics Symposium, 08-09 December 2011, Ankara, Turkey, www.tukmd.org.tr/sempozyumlar/index_eng.php

4th International Conference on Grouting and Deep Mixing, February 15-18, 2012, New Orleans, Louisiana, USA, www.grout2012.org

3rd International Seminar on Earthworks in Europe, 19 – 20 March, 2012, Berlin, Germany,

www.fgsv.de/veranstaltungen_international.html?&tx_julleevents_pi1[showUid]=85&cHash=4153b585bc

Περισσότερες πληροφορίες στην ιστοσελίδα του συμποσίου : www.tunnelcontracts2012.com

Practices and Trends for Financing and Contracting Tunnels and Underground Works
22-23 March 2012, Athens
www.tunnelcontracts2012.com

Η Ελληνική Επιτροπή Σηράγγων και Υπογείων Έργων (Ε.Ε.Σ.Υ.Ε.) οργανώνει στην Αθήνα, ένα διήμερο διεθνές συμπόσιο με θέμα **"Practices and Trends for Financing and Contracting Tunnels and Underground Works".** Οι εργασίες του συμποσίου, το οποίο έχει την επίσημη υποστήριξη της Διεθνούς Ένωσης Σηράγγων (ΙΤΑ), θα διεξαχθούν την Πέμπτη 22 και Παρασκευή 23 Μαρτίου 2012. Επίσημη γλώσσα του συμποσίου είναι τα αγγλικά. Έχουν κληθεί, ως προσκεκλημένοι ομιλητές, και έχουν αποδεχθεί την πρόσκληση, διακεκριμένοι, παγκοσμίως, εμπειρογνώμονες όπως οι κ. Martin **Knights,** Arnold **Dix**, Joe **Huse**, Robert **Galler,** Heinz **Ehrbar**, ενώ θα κάνουν επίσης παρουσιάσεις ως προσκεκλημένοι ομιλητές οι κ. Σέργιος **Λαμπρόπουλος** (Γενικός Γραμματέας Συγχρηματοδοτούμενων Έργων) και Γεώργιος **Κολυβάς** (ως εκπρόσωπος των Διαρθρωτικών Ταμείων και του Ταμείου Συνοχής). Θα υπάρξουν επίσης παρουσιάσεις και ομιλίες από χρηματοδοτικούς φορείς της Ευρωπαϊκής Ένωσης, τράπεζες, ασφαλιστικές εταιρείες, ενώ θα γίνουν από χώρες μέλη της ΙΤΑ, αλλά και κάθε ενδιαφερόμενο φυσικό ή νομικό πρόσωπο, παρουσιάσεις εμπειριών, ακολουθούμενων πρακτικών, αλλά και νέων ιδεών και προτάσεων.

Το θέμα του συμποσίου, ιδιαίτερα επίκαιρο στη φάση που βρίσκεται σήμερα η ελληνική οικονομία, παρουσιάζει μεγάλο ενδιαφέρον για τη χώρα μας, καθώς υπάρχει αυξανόμενη πίεση για τη χρηματοδότηση των υπογείων έργων. Πιστεύουμε ότι το συμπόσιο θα αποτελέσει ένα χρήσιμο forum για την παρουσίαση και ανάδειξη των βέλτιστων πρακτικών και τάσεων για τη χρηματοδότηση και συμβασιοποίηση των υπογείων έργων και θα συμβάλλει στην καλύτερη προσέγγιση όλων των συναφών ζητημάτων.

Το Δ.Σ. της Ε.Ε.Σ.Υ.Ε. και η Οργανωτική Επιτροπή του Συμποσίου, καλούμε και παροτρύνουμε κάθε ενδιαφερόμενο φορέα ή φυσικό πρόσωπο, να υποβάλλει εργασία προς παρουσίαση αλλά και να συμμετάσχει στις εργασίες του συμποσίου.

ΠΡΟΘΕΣΜΙΕΣ ΥΠΟΒΟΛΗΣ ΕΡΓΑΣΙΩΝ:

Υποβολή τίτλου και περίληψης (έως 200 λέξεις) 15 Οκτωβρίου 2011

Αποδοχή περίληψης 1 Νοεμβρίου 2011

Υποβολή τελικού κειμένου 31 Δεκεμβρίου 2011

6th Colloquium "Rock Mechanics - Theory and Practice" with "Vienna-Leopold-Müller Lecture", 22-23 March 2012, Vienna, Austria, christine.cerny@tuwien.ac.at

GeoCongress 2012 State of the Art and Practice in Geotechnical Engineering, Oakland, California, USA, March 25-29, 2012, www.geocongress2012.org

TERRA 2012 XIth International Conference on the Study and Conservation of Earthen Architecture Heritage, 22 – 27 April 2012, Lima, Peru, http://congreso.pucp.edu.pe/terra2012/index.htm

GEOAMERICAS 2012 II Pan-American Congress on Geosynthetics, Lima, Perú, 2 - 5 May 2012 www.igsperu.org

16th Nordik Geotechnical Meeting, 9-12 May, 2012, Copenhagen, Denmark www.ngm2012.dk

ITA-AITES WTC 2012 "Tunnelling and Underground Space for a global Society", Bangkok, Thailand, 18 to 23 May, 2012, www.wtc2012.com

Fifth International Symposium on Contaminated Sediments: Restoration of Aquatic Environment, May 23 - 25 2012, Montreal, QC, Canada, www.astm.org/SYMPOSIA/filtrexx40.cgi?+-P+EVENT_ID+1857+/usr6/htdocs/astm.org/SYMPOSIA/callforpapers.frm

EUROCK 2012 - ISRM European Regional Symposium - Rock Engineering and Technology, 27 – 30 May 2012, Stockholm, Sweden, www.eurock2012.com.

SECOND INTERNATIONAL CONFERENCE ON PERFORMANCE-BASED DESIGN IN EARTHQUAKE GEOTECHNICAL ENGINEERING, May 28-30, 2012, Taormina, Italy, www.associazionegeotecnica.it

INTERNATIONAL SYMPOSIUM & SHORT COURSES TC 211 IS-GI Brussels 2012 Recent Research, Advances & Execution Aspects of GROUND IMPROVEMENT WORKS, 30 May – 1 June 2012, Brussels, Belgium, www.bbri.be/go/IS-GI-2012

12th Baltic Sea Geotechnical Conference "Infrastructure in the Baltic Sea Region", Rostock, Germany, 31 May – 2 June, 2012, www.12bsgc.de

80th Annual Meeting 24th ICOLD Congress
June, 2nd to 5th, 2012 June, 6th to 8th, 2012
http://icold2012kyoto.org/

The CIGB-ICOLD Organizing Committee for ICOLD 2012 Kyoto is pleased to invite professionals, managers and decision makers from the international dam community to the International Symposium on DAMS FOR A CHANGING WORLD, Need for Knowledge Transfer across the Generation & the World. The Symposium will be held on June 5 during the 80th Annual Meeting and the 24th Congress from June 2 to 8, 2012.

Papers are invited related to themes listed below.

(1) Impacts of Climate Change on Dams and the Benefits from Dams
- Role of dams in the adaptation to climate change
- Assessment of climate change impacts on water resources and floods
- Climate change impacts on water storage facilities and its mitigation
- Role of hydropower in a low carbon society
- Guidance and polices on climate change adaptation planning
- Research needs for a more reliable knowledge on climate change
- The impact of climate change on dam safety
- The role of dams in mitigating storm floods
- The monitoring and operation of dams during flood

(2) Dams for Meeting Increasing Demand of Growing World Population
- Food, energy and water - needs for dams in developed and developing countries
- Coexistence of dams with society and the environment
- Management of reservoir sedimentation
- Financial aspects of dams
- Institutional, planning and regulatory aspects
- The benefits of dams and new technologies in provid-ing potable water supply

(3) Knowledge & Technology Transfer in Dam Engineering
- Knowledge transfer & succession planning
- Transfer of information across the world
- Methods of information transfer to the next generation
- Case studies of technology transfers

(4) Advanced Technologies for Construction of Dams
- Recent development in RCC dams and hardfill (CSG) dams
- Recent development in embankment dams
- Recent development in appurtenant structures

(5) New Techniques to Prevent and Manage Incidents & Accidents
- Information and communication technology for operation and monitoring
- Technologies to prevent accidents and incidents
- Remedial technologies
- Case studies

(6) Earthquakes
- Recent strong earthquakes and the behavior of dams
- Lessons from case histories of dams and appurtenant structures subject to earthquakes
- New methodologies to predict causative faults and earthquake ground motions
- Design and operation of hydraulic structures to resist earthquakes
- Emergency measures taken after earthquakes
- Performance monitoring for seismic events

(7) Geotechnical Aspects of Dam Foundations
- New techniques in exploration and evaluation
- Treatment technologies: efficiency and long-term performance
- Treatment of difficult geological conditions
- Design technologies for dams on weak foundations

(8) Others

Organizing Committee, ICOLD 2012 Kyoto
Address: Toranomon-Yatsuka Bldg. 8F., 1-1-11, Atago, Minato-ku, Tokyo 105-0002 Japan
Tel: (81-3)3459-0946 Fax: (81-3)3459-0948
E-Mail: contact@icold2012kyoto.org
URL: http://icold2012kyoto.org

ISL 2012 NASL 11th International Symposium on Landslides, 3 ÷ 8 June 2012, Banff, Alta, Canada, corey.froese@ercb.ca, www.ISL-NASL2012.ca

ASTM Symposium on Dynamic Testing of Soil and Rock: Field and Laboratory, June 28 - 29 2012, San Diego, CA, USA, www.astm.org/D18symp0612.htm

Protection and Restoration of the Environment XI
July 3-6, 2012, Thessaloniki, Greece
www.pre11.org

"Protection and Restoration of the Environment" is a well-known series of international conferences, which started in 1992, in Thessaloniki, Greece. Since then they have been organized jointly by one American and one Greek University every two years. In 2012, which marks the twentieth anniversary of the Conference series, it will take place in Thessaloniki again. Organizers are the Stevens Center for Envi-

ronmental Engineering of the Stevens Institute of Technology, USA and the Division of Hydraulics and Environmental Engineering, together with the Environment Council of the Aristotle University of Thessaloniki, Greece.

Thessaloniki is an inspiring place for an environmental conference: It is a large city, facing many environmental problems, but, at the same time, it is situated in the middle of an area of undisputable beauty, which exhibits the environmental quality that we have to preserve for future generations. Moreover, it is located in a rather small distance from Stagira, the birthplace of Aristotle, and Mount Athos. Aristotle contributed decisively to the formation of scientific thought, while Mount Athos represents the spirit and the moral discipline, which are indispensable for the restoration of the environment.

The conference is timely, too. In the middle of a financial crisis, it serves as a reminder that protection of the environment is not a luxury, that could be temporarily disregarded, but a basic prerequisite for a viable future.

Main topics

- Air quality and contamination control
- Cultural and social issues
- Ecotoxicology
- Environmental economics
- Environmental education
- Environmental fluid mechanics
- Environmental geotechnology
- Environmental health
- Environmental impact assessment and risk analysis
- Environmental law and policy
- Global environmental changes Indoor air pollution
- Natural treatment systems Protection and restoration of ecosystems
- Protection and restoration of coastal zone and open sea waters
- Sediment transport and erosion control
- Soft energy sources
- Solid waste management Sustainable architecture, planning and development
- Transport and fate of pollutants in the environment-mathematical and numerical modelling
- Waste minimization and pollution prevention
- Wastewater treatment and management
- Water resources management and contamination control

For more information:

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Koutsospyros M, Stevens Institute of Technology, e-mail: AKoutsospyros@newhaven.edu

N. Theodossiou, Department of Civil Engineering, A.U.Th., Greece, e-mail: niktheod@civil.auth.gr

Shaking the Foundations of Geo-engineering Edaucation, International Conference on Geotechnical Engineering Education, 4-6 July 2012, NUI Galway, Galway, Ireland, bryan.mccabe@nuigalway.ie

ANZ 2012 "Ground Engineering in a Changing World" 11th Australia-New Zealand Conference on Geomechanics, Melbourne, Australia, 15-18 July 2012, www.anz2012.com.au

A Symposium on
EXPERIMENTAL STUDIES WITH GEOSYNTHETICS
In Conjunction with
15th INTERNATIONAL CONFERENCE ON EXPERIMENTAL MECHANICS (ICEM15)
Porto, Portugal, July 22-27, 2012
http://paginas.fe.up.pt/clme/icem15

In the last decades geosynthetics have been used successfully in different areas of civil engineering, namely, geotechnical engineering, environmental engineering, hydraulic engineering and transportation engineering. Although several studies have been carried out on experimental characterization of geosynthetics properties and its behaviour on usual applications, it is of the utmost importance to develop research, and to discuss the results, to a better understanding of the real improvement achieved with geosynthetics use. This symposium is focused at discussion of the most recent developments in experimental characterization of geosynthetics and field applications behaviour.

The purpose of this symposium is that researchers, designers, manufacturers, applicators and other persons who are interested in this field exchange their experiences related to experimental studies involving geosynthetic materials. Papers concentrating on geosynthetic testing and properties, soilgeosynthetic interaction, durability, drainage and filtration tests, reduced scale models, large scale laboratory and field tests are welcome to this symposium.

For additional information, please contact either of the following:

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Geotechnique Themed Issue 2012 "Offshore Geotechnics", www.geotechnique-ice.com

34th International Geological Congress 5 ÷ 15 August 2012, Brisbane, Australia, http://www.ga.gov.au/igc2012

ICSE-6, 6th International Conference on Scour and Erosion, 27-31 August 2012, Paris, France, www.icse-6.com

2nd International Conference on Transportation Geotechnics, 10 - 12 September 2012, Sapporo, Hokkaido, Japan, http://congress.coop.hokudai.ac.jp/tc3conference/index.html

7th International Conference in Offshore Site Investigation and Geotechnics: Integrated Geotechnologies, Present and Future
12-14 September 2012, London, United Kingdom

The Offshore Site Investigation and Geotechnics (OSIG) Group of the SUT is pleased to announce its 7th International Conference, "Integrated Geotechnologies - Present and Future".

The needs of the offshore industry have evolved substantially since the first conference held in 1979. While foundation developments continue to be important, there is now greater emphasis on integrating marine geology, geophysics and geotechnics. New challenges are being presented in geohazard assessments and geotechnical aspects of renewable energy, deepwater developments, floating production, pipelines, subsea tie backs and new environmental conditions.

Organizer: TC209, SUT – OSIG

Contact person: Peter Allan
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England
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E-mail: peter.allan@geomarine.co.uk; zenon@tamu.edu

EUROGEO5 - 5th European Geosynthetics Conference, 16 - 19 September 2012, Valencia, Spain, www.eurogeo5.org

IS-Kanazawa 2012
The 9th International Conference on Testing and Design Methods for Deep Foundations
18-20 September 2012, Kanazawa, Japan
http://is-kanazawa2012.jp

Foundation design is changing from conventional design methods to design frameworks such as limit state approaches; performance-based design; load and resistance factor design or probabilistic design. In this context, load tests of single piles and plate-load tests on a construction site are necessary as 'element tests' for design of foundation systems such as pile groups (and rafts). The number of tests on site is also a key factor in the foundation design. Hence, the role of dynamic tests including rapid load and vibratory test methods are becoming increasingly important in the processes of the new design frameworks.

The objective of the conference is to provide an international forum for practitioners, academics and researchers from various countries to share and disseminate their knowledge, experience and expertise in the field of pile engineering. Emphasis will be placed on the effective use of pile testing applied to design of foundation systems.

The word "Testing" covers the full range of test methods including Dynamic Load Testing (DLT), Rapid Load Testing (RLT), Sonic Integrity Testing (SIT), other integrity testing, Static Load Testing (SLT), ground investigations and related numerical and physical modeling while "Design" implies the use of the test and experimental results in the design of whole foundation systems such as pile groups and piled raft foundations.

The conference will also include papers relating to the testing of shallow foundations and informative case histories involving 'testing' and 'design'.

1. Application of stress-wave theory to piles
   - 1. 1. Wave mechanics applied to pile engineering
   - 1. 2. Relationship between static resistance to driving and long-term static soil resistance
   - 1. 3. Case histories involving measurement and analysis of stress waves
   - 1. 4. Dynamic monitoring of driven piles
   - 1. 5. Numerical and physical modeling of dynamic soil-pile interaction
   - 1. 6. High-strain dynamic testing
   - 1. 7. Low-strain dynamic testing
   - 1. 8. Rapid load testing
   - 1. 9. Monitoring and analysis of vibratory driven piles
   - 1.10. Correlation of dynamic and static pile load tests
   - 1.11. Quality assurance of deep foundations using dynamic methods
   - 1.12. Incorporation of dynamic testing into design codes and testing standards
   - 1.13. Ground vibrations (environmental impact) induced by pile motions
   - 1.14. Drivability analysis for impact and vibratory hammers
   - 1.15. Dynamic horizontal load testing
2. Other pile load test and analysis methods
   - 2.1. Static load testing
   - 2.2. Osterberg cell tests
   - 2.3. Horizontal load testing
   - 2.4. Tension load testing
   - 2.5. Numerical and physical modeling of static soil-pile interaction
   - 2.6. New test methods for deep foundations
3. Pile integrity test methods other than sonic integrity (low-strain) testing
4. Testing other than pile testing
   - 4.1. Static and dynamic plate load testing
   - 4.2. Dynamic methods for ground investigations
5. Use of test results in the design of a foundation system (such as a pile group, piled raft, etc.)
   - 5. 1. Construction control of piles
   - 5. 2. Testing programs of quality control techniques for piling projects
   - 5. 3. Re-use of existing old foundations
   - 5. 4. Applying pile test results to design of piled foundations
   - 5. 5. Design of foundation systems based on reliability, probabilistic, or statistical approaches

5. 6. Design of foundation systems based on performance-based design approach
5. 7. Application of pile test results to design in an LRFD context
5. 8. Statistical methods for designing test programs and evaluating test results
5. 9. Economic considerations for deep foundation design and testing
5.10. Environmental considerations for deep foundation design and testing
5.11. Correlation of results of pile tests, soil tests, and site investigations
5.12. Incorporation of pile testing into design codes and testing standards

6. Testing and design methods for energy piles

7. Case histories involving testing and design

8. Others

For questions about the Conference, please contact:

E-mail: office@ is-kanazawa2012.jp
(matsumot@t.kanazawa-u.ac.jp)
Homepage: http://www.is-kanazawa2012.jp
Address: IS-Kanazawa 2012 Organizing Committee
Att. Prof. Tatsunori Matsumoto
Department of Civil Engineering, Kanazawa University,
Kanazawa, 920-1192, JAPAN
Phone and Fax: (+81) 76-234-4625

ISC' 4 4th International Conference on Geotechnical and Geophysical Site Characterization, September 18-21, 2012, Porto de Galinhas, Pernambuco – Brazil, www.isc-4.com

SAHC 2011, 8th International Conference on Structural Analysis of Historical Constructions, October 15 – 17, 2012, Wroclaw, Poland, www.sahc2012.org

7th Asian Rock Mechanics Symposium, 15-17 October 2012, Seoul, Korea, www.arms7.com

International Conference on Ground Improvement and Ground Control: Transport Infrastructure Development and Natural Hazards Mitigation, 30 Oct - 2 Nov 2012, Wollongong, Australia www.icgiwollongong.com

ACUUS 2012 13th World Conference of the Associated Research Centers for the Urban Underground Space Underground Space Development – Opportunities and Challenges, 7 – 9 November 2012, Singapore, www.acuus2012.com

32. Baugrundtagung with exhibition "Geotechnik", Mainz, Germany, 26 – 29 November 2012

GEOSYNTHETICS ASIA 2012 (GA2012) 5th Asian Regional Conference on Geosynthetics, Bangkok, Thailand, 10 - 14 December 2012, www.set.ait.ac.th/acsig/igs-thailand

First International Congress FedIGS, 12 – 15 November 2012, Hong Kong – China, www.fedigs.org/HongKong2012

GA2012 - Geosynthetics Asia 2012 5th Asian Regional Conference on Geosynthetics, 10 - 14 December 2012, Bangkok, Thailand, www.set.ait.ac.th/acsig/GA2012

Geotechnical Special Publication, ASCE "Foundation Engineering in the Face of Uncertainty". Abstracts to Mohamad H. Hussein at: MHussein@pile.com.

Geotechnical Special Publication, ASCE "SOUND GEOTECHNICAL RESEARCH TO PRACTICE", http://web.engr.oregonstate.edu/~armin/index_files/HoltzGSP

Themed Issue on
Geotechnical Challenges for Renewable Energy Developments

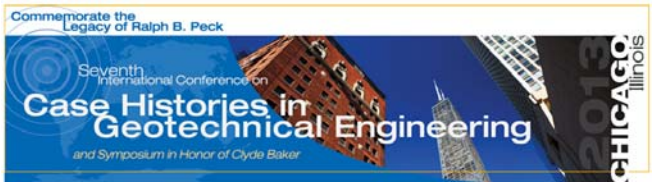
Geotechnical Engineering will publish a themed issue on the subject of Geotechnical Challenges for Renewable Energy Developments in 2013.

The issue will focus on the following topics associated with the geotechnical engineering practice in the field of renewable energy development:

- Case histories
- Geotechnical investigation and monitoring
- Geotechnical analysis and modelling
- Innovative foundation systems for offshore and onshore wind farms
- Geotechnics of pipelines and cable transmission systems
- Barrages
- Geotechnical aspects of ocean wave and ocean current projects
- Geothermal energy

Those who wish to publish should send a breief aoutline of their paper to ben.ramster@icepublishing.com by 30th November 2011.

Fifth International Conference on Forensic Engineering Informing the Future with Lessons from the Past, 15-17 April 2013, London, United Kingdom, http://ice-forensicengineering.com



Conference to Commemorate the Legacy of Ralph B. Peck, 7th International Conference on Case Histories in Geotechnical Engineering & Soil Dynamics and Symposium in Honor of Clyde Baker, Chicago, USA, April/May, 2013, http://7icchge.mst.edu

ITA-AITES WTC 2013 "Underground – the way to the future", Geneva, Switzerland, 10 to 17 May 2013, www.wtc2013.ch/congress

Effective and Sustainable Hydraulic Fracturing - an ISRM Specialized Conference
20-22 May 2013, Brisbane, Queensland, Australia

The Conference will focus on three technical themes:

1. Advancing Effectiveness presenting the latest advances in simulation, theory, field and laboratory experimentation, and case studies with an emphasis on petroleum resources

2. Exploring Versatility presenting methods and lessons from a diversity of application domains

3. Promoting Sustainability driving toward differentiation between real and perceived risks, deployment of viable controls, and beneficial public engagement.

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18th International Conference on Soil Mechanics and Geotechnical Engineering "Challenges and Innovations in Geotechnics", 1 – 5 September 2013, Paris, France www.paris2013-icsmge.org

Géotechnique Symposium in Print on Bio- and Chemo-Mechanical Processes in Geotechnical Engineering, www.elabs10.com/content/2010001471/SIP%202013.pdf

EUROCK 2013
ISRM European Regional Symposium
Rock Mechanics for Resources, Energy and Environment
23-26 September 2013, Wroclaw, Poland

Contact Person: Prof. Dariusz Lydzba
Address: Wroclaw University of Technology
Faculty of Civil Engineering
Department of Geotechnics and Hydrotechnics
9, Plac Grunwaldzki
PL-50-377 Wroclaw
Telephone: (+48) 71 320 48 14
Fax: (+48) 71 320 48 14
E-mail: dariusz.lydzba@pwr.wroc.pl

ANDORRA 2014 14th International Winter Road Congress 2014, 4-7 February 2014, Andorra la Vella (Andorra), www.aipcrandorra2014.org

8th European Conference "Numerical Methods in Geotechnical Engineering", Delft, The Netherlands, 18-20 juni 2014, www.numge2014.org

10th International Conference on Geosynthetics – 10ICG, Berlin, Germany, 21 – 25 September 2014 www.10icg-berlin.com

13th ISRM International Congress on Rock Mechanics
Innovations in Applied and Theoretical Rock Mechanics
29 April – 6 May 2015, Montreal, Canada

The Congress of the ISRM "Innovations in Applied and Theoretical Rock Mechanics" will take place on 29 April to 6 May 2015 and will be chaired by Prof. Ferri Hassani.

Contact Person: Prof. Ferri Hassani
Address: Department of Mining and Materials Engineering
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Telephone: + 514 398 8060
Fax: + 514 398 5016
E-mail: ferri.hassani@cGill.ca

ΝΕΑ ΑΠΟ ΤΙΣ ΔΙΕΘΝΕΙΣ ΕΝΩΣΕΙΣ

Valedictory Message from
Professor John A Hudson
ISRM President, 2007 - 2011

My four-year tenure as ISRM President began at the end of the ISRM Lisbon Congress in 2007 and will finish at the end of the ISRM Beijing Congress, i.e., at about 18.00 on Friday 21 October in 2011. So, I am saying goodbye now through this Newsletter, which is the last during my Presidential period.

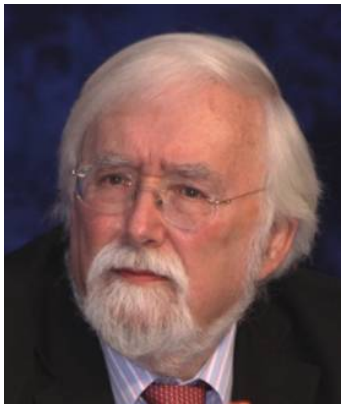
It was an honour to have been voted into the Presidential position and I hope that, together with the 2007–2011 ISRM Board, I have served you all well. My theme was modernisation and we have indeed implemented almost 30 initiatives over the four years, including

- the launch of the ISRM Virtual Library hosted at www.OnePetro.org,
- the creation of ISRM Fellows,
- the introduction of the ISRM Annual Lecture,
- running ISRM Lecture Tours and ISRM Field Trips,
- ensuring that the ISRM Commissions are productive, and
- organising the ISRM 50-year Anniversary celebrations,

the full list being given on page 6 of the 2010 ISRM News Journal.

One needs a great deal of help to achieve all these goals and I wish to especially acknowledge the ISRM Board members for their inspiration, resourcefulness and support in the generation and implementation of the initiatives. Additionally, the ISRM Secretariat headed by Dr Luis Lamas has provided invaluable advice, assistance and hard work over the four years.

Finally, I should like to assure all ISRM members that my successor, Professor Xia-Ting Feng of the Institute of Rock and Soil Mechanics, Chinese Academy of Sciences, will provide exemplary ISRM Presidential leadership for the next four-year period.



Election of the Regional ISRM Vice Presidents 2011-2015

Election of the ISRM Regional Vice Presidents 2011-2015 will take place at the Council meeting to be held on 17 October 2011 in Beijing, China. As part of the current ISRM Board's modernisation programme, the Board wishes to ensure that ISRM members have the opportunity to learn about the candidates experience and intentions. Accordingly, we have asked the candidates to provide 10 minute videos of their background and intentions. These videos are available on the ISRM website, from where the candidates nomination documents can be also downloaded.

Nominated for VP Europe

Prof. Scott Kieffer, Austria

Prof. Gian Paolo Giani, Italy

Prof. Frederic Pellet, France

ISRM 50th Anniversary Young Members' Slide Show Competition
"The Future Directions for Engineering Rock Mechanics"

Six excellent slide shows were submitted to the competition open to young members of the ISRM to present their vision of The Future Directions for Engineering Rock Mechanics. Candidates were asked to prepare a fully explanatory PowerPoint slide show explaining, illustrating and justifying their ideas.

Dr Ricardo Resende from Portugal won the competition and you can click on the following web page http://www.isrm.net/fotos/editor2/nl15/ricardoresende_future_for_erm.pdf to dowload his winning slide show.

Ricardo is a member of the ISRM Young Members' Presidential Group and he will make a presentation based on his winning slide show at the Second ISRM International Young Scholars' Symposium on Rock Mechanics, which will take place in Beijing, China, on 14-16 October 2011, immediately preceding the 12th ISRM International Congress.

Networking among Underground Research Laboratories is for a New ISRM Commission, 2011-2015 (*)

The new ISRM Commission is to be launched at Workshop WS5 on 17 October 2011, associated with the Beijing Congress.

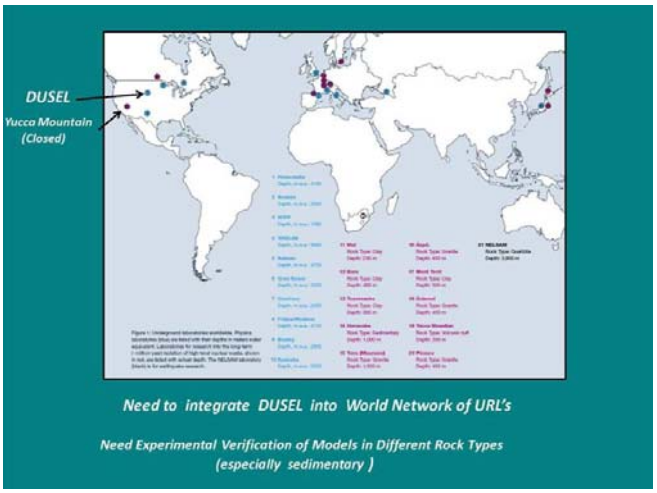
All of you are welcomed to attend, participate, and contribute to WS5 on Monday 17 October 2011, right before the technical sessions of the Congress during 18-21 October at Beijing. We will have lectures and discussion/updates to address the needs and logistics of the initiative for a worldwide networking effort among Underground Research Laboratories (URLs). It will be an informal and informative gathering during a very busy day with concurrent short courses, workshops, commissions, and executive meetings. You can certainly drop in for the WS5 lectures and topical discussions and provide your inputs. Even if you have schedule conflicts, we welcome your inputs for the new Commission scope and contributions to the Workshop Proceeding which will be published in an ISRM Book series. Please feel free to contact Joe Wang jswang@lbl.gov for any details. We appreciate your indications and considerations for availabilities to participate in the workshop, to help in formulating the Commission, and to indicate your interests.

The New URL Networking Commission concept is a relatively recent development, endorsed by John A. Hudson and Xia-Ting Feng, our current and incoming Presidents. You are invited to provide inputs to the Commission scope and to nominate potential Commissioners for consideration by John Hudson and Xia-Ting Feng at the Beijing Congress. We are seeking supports from regional and national groups, from ISRM community at large, and from other related fields.

As indicated below, and to be updated on the Congress web site (http://www.isrm2011.com/upload/shortcourse/WS5.pdf), the WS5 agenda has 5 technical sessions to cover 10 topics that are listed in the original workshop announcement. In the morning sessions, we will cover rock mechanics challenges in deep facilities, deep underground laboratories primarily for physics searches, and URLs designated for radioactive waste assessment. We then have afternoon sessions on site characterization, couple process testing, and inter-disciplinary studies. We will have both a pre-commission briefing at the beginning of first session, and a last session on discussions of initiatives to kick off the new Commission. The Workshop Proceedings with preprints, presentations, and proposals files hyperlinked will be periodically updated on http://dl.dropbox.com/u/7798101/URL-NetworkPPP/TemperateISRM2011.doc.

We are looking forward to meeting you at the Workshop, throughout the Congress, and to receiving your indications of interests and inputs in the months and years to come. The World Network of URLs and a call for integration by Professor Charles Fairhurst at the Deep Underground Science and Engineering Laboratory (DUSEL) Research Association 2010 meeting are illustrated below.

Joseph S.Y. Wang



(*)

Networks of Underground Research Laboratories for International, Inter-disciplinary Innovations

Proceedings of an International Society for Rock Mechanics Workshop on
17 October 2011, Beijing, China
associated with the ISRM 12th International Congress on Rock Mechanics

Underground Research Laboratories (URLs) were initially developed in the 1970s in Sweden for thermal and hydrological responses to emplacements of spent nuclear materials. Over a dozen URLs have since been and established and planned worldwide for studying coupled thermal-hydrological-mechanical-chemical-biological or THMCB processes. Similar number of underground facilities has been developed for physics research, mostly at great depths along roadway tunnels and in mine levels. There are growing interests to use underground laboratories for energy and environmental studies and with emphasis in multi-disciplinary and inter-disciplinary approaches. This URL workshop discusses if networking among underground laboratories can be further developed from state of knowledge gained from past experience, current status of operation, and evolving plans. The original list of topics planned to be discussed is given in Table 1.

Table 1. Topics Planned for the URL Workshop

1	From Sweden to China's Competent, Barely Fractured Sites and Deep Tunnels
2	Challenge and Progress of Design of Wide-Span Caverns at Depths
3	Physics Deep Labs for Search of Rare Events from the Birth of the Universe (including geodynamics studies, …)
4	URL Programs in Hard and Soft Rocks: Similarities and Differences
5	Underground Injection and Withdrawal Assessments (including CO2 sequestration, shale gas production, …)
6	Fractured Rock Characterizations in Japanese, European and North American Sites
7	From Tuff to Metamorphic Rocks at Depths — Coupled THMCB Testing and Modeling
8	Bio-Seismic Coupling and Search of the Origin of Life
9	Hydro-Mechanical Coupled Tests and Induced Seismicity, Seismic-EM Couplings
10	From Underground, Surface, to Ionosphere

INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION

Message from In Mo LEE, ITA President

Dear ITA Colleagues

The 37th ITA General Assembly and World Tunnel Congress 2011 were held in May 20th~26th in the beautiful city of Helsinki. Thanks to the great effort of the Finnish Tunnelling Association, it was really a successful Congress with 1405 registered participants.

I am also very pleased to inform you that besides 58 existing member nations, six new countries, Azerbaijan, Belarus, United Arab Emirates, Nepal, Panama, and Serbia, joined us as an ITA family in the General Assembly ending up with 64 member nations. Moreover, besides ten existing prime sponsors, BASF, HERRENKNECHT, IMPLENIA, CATERPILLAR (LOVAT), MAPEI, MOT, NORMET, ROBBINS, SIKA, and STC, two new companies, ATLAS COPCO and SANDVIK, joined the category of prime sponsors. Moreover, besides three active ITA committees, ITA COSUF, ITA CUS, and ITA CET, a new committee, ITA TECH was established and approved in the General Assembly so that it will enable ITA to stay ahead of market and technology development. I believe all of these examples clearly self-prove that we have been stepping into widening the horizon of ITA, and hope that this effort continues for the forthcoming year until we meet again in Bangkok Congress.

I wish you have a wonderful summer (or winter in the Southern Hemisphere) holiday.

In-Mo Lee
President of ITA 2010-2013

Thirty Seventh Annual Meeting – Helsinki 2011

The International Tunnelling and Underground Space Association held its thirty seventh meeting in Helsinki, Finland, from 20 to 25 May 2011, in conjunction with the World Tunnel Congress 2011 "Underground Space in the service of a sustainable society" organised by ITA, the Finnish Tunnelling Association and the Finnish Association of Civil Engineers – RIL. More than 1400 persons participated to the Congress. 49 of the 64 Member Nations participated or were represented in the General Assembly, including 5 proxy.

MEMBER NATIONS PRESENT OR REPRESENTED

South Africa, Germany, Argentina, Australia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Brazil,, Canada, Chile, China, Colombia, Republic of Korea, Croatia, Denmark, Egypt, Spain, United States of America, Finland, France, Greece, Hungary, India, Indonesia, Iran, Italy, Japan, Laos, Malaysia, Mexico, Montenegro, Nepal, Norway, The Netherlands, Poland, Portugal, Romania, United Kingdom, Russia, Singapore, Slovakia, Slovenia, Sweden, Switzerland, Czech Republic, Thailand, Turkey

MEMBER NATIONS NOT PRESENT

Algeria, Saudi Arabia, Bulgaria, United Arab Emirates, Iceland, Israel, Kazakhstan, Lesotho, Morocco, Panama, Peru, Serbia, Ukraine, Venezuela, Vietnam.

MEMBERSHIP

The Association has registered the membership of six new Member Nations, Azerbaijan, Belarus, United Arab Emirates, Nepal, Panama and Serbia, and 20 new Affiliate Members (15 Corporate Members and 5 Individual Members); the total results to 64 Member Nations and 310 Affiliate Members (187 Corporate Members and 123 Individual Members) taking into account some resignations.

NEXT ANNUAL MEETINGS

- Bangkok, Thailand, from 18 to 23 May, 2012, during the ITA - AITES WTC 2012 "Tunnelling and Underground Space for a global Society"
- Geneva, Switzerland, from 31 May to 5 June 2013, during the ITA - AITES WTC 2013 "Underground – the way to the future"
- Sao Paulo, Brazil, from 9 to 15 May, 2014, during the ITA - AITES WTC 2014 "Tunnels for Better Living"

GeoWorld

Dear members of the ISSMGE,

My name is Dimitrios Zekkos and I am the Chair of the Board-level Innovation and Development Committee (IDC) of the ISSMGE. You recently received an announcement from the ISSMGE President about the development of Geoworld (GW). Geoworld is a new, free, professional networking platform for professionals, companies and professional organizations in the geoengineering profession that was developed jointly by ISSMGE and Geoengineer.org. It promotes professional networking, collaborations and information dissemination at a global scale. The following video briefly announces and describes Geoworld: http://www.youtube.com/watch?v=MRYA-mMSGCw&feature=player_embedded

Geoworld was officially announced two weeks ago and is already experiencing a major influx of geotechnical engineers who are registering as members. There are already over 600 individuals, and 22 companies registered and 42 professional groups formed.

The ISSMGE has a profile page on GW and has already created a page for each of the Technical Committees. This means that each of the ISSMGE Technical Committees can promote its activities through Geoworld to the geotechnical profession. If your committee has a website already, the Geoworld page can be used to promote updates of this website. If not, you can use the GW page as the TC webpage. Your TC GW page allows geotechnical engineers to register to it and follow all the news, updates, announcements, and files that your committee posts there. It is like an embedded mailing list of individuals who are interested on the domain of the TC. Through GW each of the TCs is empowered independently to promote its activities and reach out to the geo-professionals who have expressed interest in them. In the future, when your TC releases a publication, wishes to promote a conference, or simply wants to make an announcement, it will have the ability to immediately target an audience of interested geotechnical engineers worldwide. This means that as members of the TC, you have more tools at your disposal to engage participation in your committee and organize activities. In addition to announcements, you can use the GW page to host files, host forums, promote conferences, compile a list of publications, or host videos, photos. All information is automatically indexed and searchable by GW members. The IDC and the Geoengineer.org staff are here to support you in taking full advantage of these opportunities. You can contact me directly or the Geoengineer.org Information Technology staff at it@geoengineer.org for assistance. In addition, if there are additional needs/features that you would like to see incorporated, we will include them in our priority list. We are currently working on a number of new features for GW and we expect many more valuable features to be added in the near future.

You will receive an invitation from the ISSMGE to join Geoworld soon after this e-mail. By accepting you can create an account and establish your professional network. Creating your account should be very easy. You can then join the TCs of your interest as well as other professional groups. You can also form new groups to support your professional activities.

To support this experience, Geoengineer.org has a created a series of "How-to" instruction videos (http://www.mygeoworld.info/pg/expages/read/Instruction s/ , tips (http://www.mygeoworld.info/pg/expages/read/Tips/), and a list of Frequently-Asked-Questions (FAQ) (http://www.mygeoworld.info/pg/expages/read/FAQ/).

We hope that you will find this a new, unique and valuable tool for your professional activities. Feel free to contact me if you have any questions,

Regards,

Dimitrios Zekkos

Chair of ISSMGE Innovation and Development Committee (IDC)

http://www.mygeoworld.info/pg/profile/zekkos

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Studying the Japan quake's impact on soil will improve building design

The 11 March quake that hit Japan weakened subsurface materials by as much as 70 percent; that nonlinear response from the top layer of the Earth's crust affected how the movement of faults deep beneath the surface was delivered to buildings, bridges, and other structures; understanding how the soil responds to powerful earthquakes could be important to engineers and architects designing future buildings to withstand the level of acceleration measured in this quake

Quake caused soil liquifaction and loss of density // Source: factsanddetails.com

Japan's 11 March Tohoku Earthquake is among the strongest ever recorded, and because it struck one of the world's most heavily instrumented seismic zones, this natural disaster is providing scientists with a treasure trove of data on rare magnitude 9 earthquakes. Among the new information is what is believed to be the first study of how a shock this powerful affects the rock and soil beneath the surface.

Analyzing data from multiple measurement stations, scientists at the Georgia Institute of Technology found that the quake weakened subsurface materials by as much as 70 percent. That nonlinear response from the top layer of the Earth's crust affected how the movement of faults deep beneath the surface was delivered to buildings, bridges and other structures.

Understanding how the soil responds to powerful earthquakes could be important to engineers and architects designing future buildings to withstand the level of acceleration measured in this quake. The information will also help seismologists develop new models to predict the effects of these rare and extremely powerful events.

"The degree of nonlinearity in the soil strength was among the largest ever observed," said Zhigang Peng, an associate professor in Georgia Tech's School of Earth and Atmospheric Sciences. "This is perhaps not too surprising because the ground shaking generated by this earthquake – acceleration as much as three times the Earth's gravity – is also among the highest ever observed."

A Georgia Tech release reports that the findings were reported in a special issue of the journal *Earth, Planets and Space* (EPS). The research was sponsored the National Science Foundation (NSF) and by the Southern California Earthquake Center (SCEC).

Peng and graduate student Chunquan Wu were among the first scientists to examine data recorded by the high-quality seismometers that are part of the Japanese Strong Motion Network KIK-Net. The stations have accelerometers both on the surface and in boreholes located on bedrock far beneath it.

The researchers chose to study data from six stations that have strong velocity contrasts between the surface soil layers and the underlying bedrock.

"In this study, we were trying to understand the relationship between soil nonlinearity and peak ground acceleration (PGA), which is a measure the ground shaking," said Wu. "We want to understand what parameters control this kind of response."

By comparing data on the acceleration of motion from sensors on the bedrock to comparable information from surface sensors, they were able to study how the properties of the researchers computed the spectral ratios of each pair of station measurements, and then used the ratios to track the temporal changes in the soil response at various sites at different levels of peak ground acceleration.

"The shear modulus of the soil was reduced as much as 70 percent during the strongest shaking," Wu explained. "Typically, near the surface you have soil and several layers of sedimentary rock. Below that, you have bedrock, which is much harder than the surface material. When seismic waves propagate, the top layers of soil can amplify them."

Nonlinear response from soils is not unusual, though it varies depending on their composition. Similar but smaller effects have been seen in other earthquake-prone areas such as California and Turkey, Wu said. The shallow layers of the Earth's upper crust can be complex, composed of varying types of soil, clay particles, gravel and larger rock layered in sediments.

Because the 11 March quake lasted an unusually long time and generated a wide range of ground motions of greatly varying strengths, it provided an unprecedented data set to scientists interested in studying nonlinear soil behavior.

Beyond the immediate effect of the strongest shock, the researchers were interested in how the soils recover their strength after the shaking stops. That recovery time can vary from fractions of a second to several years, Wu said.

"It is still not clear whether there could be longer recovery times at certain sites," Wu noted. "This is a function of soil type and other factors."

If the soils are very porous, water can lengthen the recovery. "For porous media, the ground shaking could cause water to go into the pores, which will also reduce the shear modulus of the soil. If water is involved, the recovery time will be much longer."

Soil response to aftershocks, which ranged up to magnitude 7.9 after the main Tohoku earthquake, was also studied.

Information developed by the Georgia Tech researchers will be provided to seismologists developing new hazard models of very powerful earthquakes. Knowing how soils respond to strong shaking is also important to predicting how motion deep within the Earth will be translated to structures built on the surface.

"Understanding how soil loses and regains its strength during and after large earthquakes is crucial for better understanding and predicting strong ground motions," Peng noted. "This, in turn, would help earthquake engineers to improve the design of buildings and foundations, and could ultimately help to protect people in future earthquakes."

(HomelandSecurityNewsWire.com, 19 July 2011)

A gap opens under Big Dig tunnel due to sinking soil
Contracting soil in Big Dig tunnel causes more problems

State transportation officials revealed today that soil thawing underneath a Big Dig tunnel has created a gap filled with water about nine feet below the roadway. But they said they are monitoring the issue and it does not pose any risk to the traveling public.

Work crews chemically froze the soil 11 years ago so that it would not cave in as they dug into the ground and built the tunnel, which connects Interstate 90 to the Ted Williams Tunnel near South Station.

Engineers always anticipated that, as the ground thawed over the years, it would contract. However, it has receded twice as much as initially anticipated and then filled with water because the area is below the water table, officials said.

"We would not be letting cars go through there... if there were any [safety] issue whatsoever," said Richard A. Davey, the general manager of the MBTA, who takes over as state transportation secretary next month.

"We have to manage the situation, and that's what we're going to do," Davey said. "So whatever it was that was incorrect or mis-assumed back in 1995 [when the tunnel plans were drafted] we don't know. But what we are focused on is managing the situation."

The issue is the latest problem for the Big Dig, which has been under intense public scrutiny since 2006 when a section of the same tunnel, officially known as the Interstate 90 Connector, collapsed and killed a Jamaica Plain woman.

More recently, engineers have had to battle water leaks throughout the system and have had to secure thousands of tunnel light fixtures after one of them fell from the ceiling of the O'Neill Tunnel in February. This most recent problem is unrelated to the water leaks in the tunnels.

State officials have spent $15 million so far to monitor the soil thawing above and below the I-90 Connector, and have budgeted $10 million more for repairs. The money comes from a fund set up by the Big Dig's contractors.

When the area is completely thawed, at the end of 2013 or beginning of 2014, crews will suck out the water from underneath the tunnel and fill the gap with concrete.

Officials said they do not know the exact size of the space underneath the tunnel, because it is 60 feet below ground and hidden below the roadway. They said it could grow in size as the ground continues to thaw and recede over the next two years.

To assure themselves that the tunnel is safe, they conducted tests that assume the worst-case scenario: that the gap is the size of the tunnel itself. Even if the gap were that big — and engineers do not believe that it is — the tunnel would hold, much like like a bridge over a river, state officials said.

Officials had already disclosed in February 2010 that soil above the tunnel was shifting as it thawed, creating potential problems for the commuter rail and Amtrak tracks that run into South Station. But today was the first time officials revealed that ground thawing below the tunnel was also a cause for concern.

That ground has already damaged a 345-foot drainage pipe that runs between the eastbound and westbound sections of the tunnel. Several years ago, the pipe fell 8 feet out of alignment, as the ground below it contracted, officials said today. Workers built a bypass system for that pipe, at a cost of $1.2 million, and will need to replace the pipe itself once the soil is completely thawed.

The ground has been thawing since 2002, when work crews finished building the tunnel and stopped pumping saline coolant into the earth. Officials said they believed that the entire area would have thawed by now. They said they do not know whether engineering errors are to blame for the ground contracting more than initially projected.

"It's another issue that we have to monitor so that we can react if anything does manifest itself," said Frank DePaola, the state's acting highway administrator. "So far, there has been no indication of stress or strain within the tunnel sections itself."

While the damaged pipe has been the biggest problem to date, the receding ground has caused other problems in the area. Crews had to reinforce a high-voltage electrical duct for the Red Line to prevent the duct from sagging, as the ground below it contracts. They also repaved part of the parking lot for the US Postal Service facility near South Station, because the pavement there had buckled.

Officials pledged to continue monitoring the tunnel by conducting monthly inspections of the ground surface, which gives them an indication of how fast the soil below is thawing. Inspectors have also been ordered to regularly check the I-90 Connector's joints, walls, roof, and concrete for any signs of movement.

State officials are paying for the monitoring and repairs by tapping the $485 million settlement that Bechtel/Parsons Brinckerhoff -- the firms that designed and managed the Big Dig -- agreed to pay in 2008 to avoid criminal charges and civil liability stemming from leaks, the fatal ceiling collapse, and other flaws that plagued the project in the past.

(Michael Levenson / The Boston Globe / Metro Desk, August 8, 2011)

Bear River Canal Break Affects Thousands

COLFAX, Calif. -- The Placer County Water Agency is asking 38,000 customers to conserve treated water after a section of a PG&E water canal broke.

The general manager of the water agency, David Breninger, told KCRA 3 the break would directly affect 4,000 customers who rely on canal water for watering the their lawns and feeding livestock or watering crops.

The canal break is located near the town of Colfax. The Bear River Canal runs from Rollins Lake to Folsom Lake.

PG&E said a landslide took out a large section the canal that sits high on a hillside above the Bear River.

Engineers for PG&E have inspected the damage and are formulating a plan for repair, according to spokesman Paul Moreno.

The repair will likely take several weeks, according to Moreno. During that time the water agency said residents should plan on rolling 24-hour outages for non-treated water.

"Without (the water), it's going to be a problem," said Sandie Phillips, a Colfax resident who uses irrigation water on the 6 acres of land she owns.

Phillips also needs the water for her horses and her garden. She is already planning not to plant as much until the canal is fixed.

While she can use her drinking water to feed the horses, it's too expensive to use for watering her land.

"The bill goes up with everything else," said Phillips. "Between gas prices and food prices -- now the water is going to go up."

(Richard Sharp / KCRA-TV (Sacramento, Calif.), 19 Απριλ 2011)

ΠΕΡΙΒΑΛΛΟΝΤΙΚΑ

How genetic engineering of bacteria can be used to repair concrete

The pace of change in the development of new materials has been accelerating for at least a couple of decades. Even people who make it a point to keep themselves informed find themselves falling behind.

While all kinds of construction materials have changed, nowhere has the change been bigger or faster than in cement and concrete.

You just get acclimated to the changes that polymer chemistry brought to the concrete industry and nanotechnology begins to creep into the conversation. You get used to reading about genetically modified food and then, all of a sudden, you read about that kind of bioengineering applied to repairing cracked concrete.

It seems that a team of students at a British university has used genetic modification to develop a way to repair fine cracks. Their achievement holds the promise of prolonged life for concrete structures and a reduction impact that they will have on the environment over the life of the structures.

Ever hear of Bacillus subtilis? Most of us haven't. Apparently it's a bacterium commonly found in most soils. But the students from the University of Newcastle, tweaked its genetic properties and turned it into an amazing little thing that's at the heart of what the students are calling BacillaFilla.

It's not a product yet, but it might become one two or three years down the road.

The nine students, from half a dozen academic disciplines, have performed a neat trick. They've genetically modified bacteria that grow only when they come in contact with concrete. Then they "swim" down fine cracks in the concrete and produce a mixture of calcium carbonate and a bacterial glue to "knit" the concrete back together.

As the bacteria grow, they produce three types of cells. One type produces crystals of calcium carbonate; one develops filament-like cells that serve as reinforcing fibres, and the third produces glue that acts as a binding agent and fills the gap. Ultimately, the repair cures to the same strength as the surrounding concrete.

The students built a safeguard into BacillaFilla: It only germinates when in contact with concrete — triggered by the material's pH. And it has a built-in self-destruct gene so it wouldn't be able to survive should it escape into environment at large.

The calcium carbonate produced expands at the same rate as concrete, making it an ideal filler material. The B. subtilis filaments have a tensile strength similar to the synthetic fibres used in fibre-reinforced concrete. The student's backgrounds include computer science, civil engineering, bioinformatics, microbiology and biochemistry.

Cement and concrete have a bad environmental reputation. Globally, their manufacture accounts for about five per cent of all man-made carbon dioxide emissions. Extending building life will spread those emissions over a longer life cycle, with the result that a building's carbon footprint would be smaller.

While BacillaFilla could be used just about anywhere, one thinks immediately of the damage done by earthquakes, often resulting in the razing of many buildings that could be repaired. It would also be useful in the maintenance and repair of heritage buildings, and also for extending the life of public infrastructure.

The nine British students won an international gold medal for their work. The idea of the competition was to get together a team of students from a variety of backgrounds to design and genetically engineer a bacterium to do something novel and useful. More than 130 teams entered, which means a lot of good young minds are working in the field.

That should mean we can look forward to more innovative ideas and products making their way to market. It's going to be fun to watch.

Korky Koroluk / Daily Commercial News, September 29, 2011)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Video:
Geotechnical investigation of the March 11, 2011 Tohoku Earthquake, Japan

The NSF funded Geotechnical Extreme Events Reconnaissance (GEER) team has provided a preliminary report and some amazing photos and video of the damage to various regions of Japan affected by the moment magnitude 9.0 earthquake that struck on March 11, 2011. Read on to see some amazing photos and video of the liquefaction damage related to the Tohoku Earthquake in Japan. (Photos from Oregon State Flickr)

In coordination with the Japanese Geotechnical Society, the first group of GEER members, consisting of Ross Boulanger (Team Leader), Scott Ashford, Jennifer Donahue, and Jonathan Stewart visited sites in the Kanto Plain region during the period of March 26 to April 1, 2011. Their trip was constrained by time available as well as the need to stay clear of ongoing humanitarian operations as well as the limited by the crisis at the Dai-ichi nuclear power plant in Fukushima. They focused their efforts on documenting the damage to various facilities, with special attention given to evidence of damage that will be cleaned up quickly or vanish because of natural processes.

The amount of liquefaction related damage shown in their photos and video is simply staggering. They show seaports, water treatment plants, residential buildings, and town and village main streets that are covered in sand that boiled up from the ground as a result of the strong shaking. Buildings and structures have tilted, and some settled by as much as a meter or two. There is even photos showing a sewer line that floated up to the surface when the soil around it liquefied.

The data that was collected by this and other GEER teams and the follow-up analysis will allow geotechnical engineers and others to learn from the tragic events and hopefully lead to safer, more earthquake resistant designs.

Video of Liquefaction Damage from the 2011 Japan Earthquake

http://www.youtube.com/v/ryTkUY_49Lk?version=3
http://www.youtube.com/watch?v=ryTkUY_49Lk

GEOTECHNICAL EXTREME EVENTS RECONNAISSANCE

Download the **Geotechnical Quick Report on the Kanto Plain Region during the March 11, 2011, Off Pacific Coast of Tohoku Earthquake, Japan** by Scott A. Ashford, Ross W. Boulanger, Jennifer L. Donahue, and Jonathan P. Stewart - April 5, 2011

http://www.geerassociation.org/GEER_Post%20EQ%20Reports/Tohoku_Japan_2011/Cover_Tohoku_2011.html

(Randy Post, Thursday, 28 April 2011)

Εντυπωσιακά Φαινόμενα Ρευστοποίησης στην Ιαπωνία Αρκετές Ημέρες μετά τον Σεισμό

Κυκλοφορεί στο διαδίκτυο video το οποίο παρουσιάζει φαινόμενα ρευστοποίησης αρκετές ημέρες (όπως ισχυρίζονται) μετά τον σεισμό της 11ης Μαρτίου 2011. Μπορείται να το δείτε μέσω της ιστοσελίδας της ΕΕΕΕΓΜ (Ρευστοποίηση Ιαπωνίας).

Βέβαια άλλος είναι ο στόχος του video, αλλά για εμάς αρκεί αυτό που βλέπουμε…

Quake study may lead to safer building designs

CARBONDALE, Ill. -- Pluck a guitar string, and it will vibrate at a certain rate, creating pitch based on how fast or slow these oscillations occur. This vibration rate, or frequency, depends on several factors, including the structure of the string and its length.

Like guitar strings, building have frequencies, too. So when the earth moves violently during an earthquake, buildings also vibrate at their frequency, which is also based on factors such as structure, size and the type of ground in which it is anchored. In an earthquake, those vibrations can prove catastrophic.

The phenomenon, known as fundamental frequency, is a fairly well understood variable in the world of engineering earthquake-resistant structures. But there are many other variables -- perhaps 20 or more -- that are not.

Two researchers at Southern Illinois University Carbondale are hoping to change that by crunching earthquake data gathered from the United States and around the world and combining it with imaging technology and software. What comes out the other side of this effort could potentially change building codes everywhere and allow engineers to build better, safer structures to withstand earthquakes.

Jale Tezcan, assistant professor of civil and environmental engineering, and Qiang Cheng, assistant professor of computer science, recently received a three-year, $260,000 federal grant form the National Science Foundation aimed at preventing structural damage like the kind Japan suffered this spring. The two researchers, along with graduate students, have begun pulling data together and formulating software to analyze and it.

"This is a really a creative way of looking at this problem," Tezcan said. "We are converting earthquake signals into pictures and applying image processing techniques to them."

The research could fill a critical gap in the knowledge set that engineers use when designing earthquake resistance into new structures.

When they design buildings, engineers typically rely on recorded earthquake signals to ensure their buildings can take the stress of future temblors. Often, however, engineers must rely on data from earthquakes that occur in such seismic hotspots as California, even if they are designing a building for Southern Illinois.

But when it comes to how earthquakes cause damage, one size far from fits all.

Instead, many factors -- soil types, bedrock depth, plate locations and boundaries and others -- can affect how earthquake energy travels, dissipates and ultimately impacts structures. And ultimately, how it affects structures.

"The problem is we don't have enough earthquakes here that are large enough to provide such test signals," Tezcan said. "So what happens is engineers just look at earthquake signals from California, make some adjustments based on building codes and go from there. There are a few dozen variables. But building codes only use three or four. That's really unrealistic because everything is different."

California, for instance, is located along a plate boundary. The motion that occurs during a quake, therefore, would be different in character than one that occurs in the Midwest. The geological conditions also are very different. California's bedrock lies deep, which tends to isolate quake energy nearer to its source. In the Midwest, however, quake energy tends to travel much further. An earthquake that originated near Southern Illinois a few years back, Tezcan said, was felt as far away as Florida.

"A strong earthquake here would impact six to seven states," she said. "Our goal is to provide engineers with more realistic earthquake signals so they have better scenarios to design their structures."

To do this, Tezcan and Cheng will look at both the better-understood variables such as magnitude, distance and soil types, as well as the many that are not as well known, through the prism of their new approach.

"Magnitude is important, of course, as is distance and soil type as some tend to amplify seismic energy while others do not," Tezcan said. "But there are other variables too, some of which probably haven't even been discovered yet and some that researchers think may even be more important" than the ones that are known.

These other variables include factors such as the depth at which the focus of the quake occurs, as well as whether the motion is toward or away from structures.

The variables basically live in an array of databases kept both at home and abroad. In the United States, the U.S. Geological Survey keeps extensive tabs on quake variables, yet the information is not used in building codes because little is known about their effects on structures.

After gathering the USGS data, as well as data from Europe, Japan and other areas, the researchers will use computer analysis to take the quake signals, apply them to variables and turn them into pictures to figure out which variables are the most important to engineers.

Tezcan will collect the databases while Cheng will put the data through programs and processes he is creating that will identify patterns in earthquake signals using imaging technology, basically turning the signals into visual representation that researchers can interpret.

After that, Tezcan will use the data to create models that engineers will be able to apply to their unique geological situations. The work also will quantify uncertainty, which will help engineers make calculations, as well.

One key aspect will examine a quake's amplitude as distributed over time and frequency. This might potentially tell an engineer what type of destructive fundamental frequencies a quake might put out in a certain area, bringing the vibrating guitar string example back into focus.

"Every structure likes to vibrate at a certain frequency, and if the earthquake provides that particular frequency the buildings become really happy," and move back and forth more readily, Tezcan said. The work will alert engineers to such hazards, allowing them to design buildings to avoid or withstand such issues.

"We will create some scenarios of ground motions for regions," Tezcan said. "Even though there are not enough actually earthquakes to test, we hope this will allow engineers to apply the model in other areas, too."

(Tim Crosby / The Saluki Times, Southern Illinois University Carbondale, July 6, 2011)

Victoria University building breaks new ground
New earthquake-dampening technology distinguishes university building

Victoria University's Alan MacDiarmid building has been nominated as a finalist in the Association of Consulting Engineers annual Innovate awards for its pioneering use of new earthquake damping technology.

It is the first multi-storey building in New Zealand to be built using precast seismic structural systems (PRESSS) which use un-bonded post-tensioning to allow controlled rocking of joints.

This softens the blow of an earthquake, springing the building back to upright without significant structural damage even after a major earthquake.

Dunning Thornton were engineering designers for the building which was described as being flexible and using a system that reduced movement almost as much as base-isolation but at a fraction of the cost.

The same system has recently been proven in Christchurch, where it was used in the new Southern Cross Hospital endoscopy building in Richmond.

Although it sustained minor damage from the February 22 earthquake it was soon operational and put to use as a supplementary triage centre for Christchurch Hospital.

Other Wellington finalists in the Innovate awards are:

Beca for its work on three complex projects, the SH2 Dowse to Petone highway upgrade, Zealandia - The Karori Sanctuary Experience and the International Passenger Terminal stage two at Wellington Airport

Aurecon for the clearance assessment for the Johnsonville rail tunnel which allowed larger units to replace the 1930s English electric trains that had been in service for the past 80 years.

The awards recognise innovation in engineering structures, processes and services.

Convenor of judges Allan Leahy said the projects ranged from hospital design to wastewater, farming and leisure projects.

"These are New Zealand firms, delivering innovative, groundbreaking and often unique technical solutions to many complex projects which benefit millions of people in New Zealand and beyond in their everyday lives," Leahy said.

The Dominion Post (New Zealand) (7/19)

Διαδραστική δραστηριότητα για μικρούς και μεγάλους

Σεισμοί, τσουνάμι & μέτρα προστασίας στο Μουσείο Φυσικής Ιστορίας Απολιθωμένου Δάσους Λέσβου

Προσομοίωση του μεγάλου σεισμού της Ιαπωνίας και άλλων ισχυρών σεισμών από την Ελλάδα και όλο τον κόσμο μπορούν να βιώσουν οι επισκέπτες του Απολιθωμένου Δάσους στη σεισμική τράπεζα του Μουσείου.

«Σεισμοί, τσουνάμι & μέτρα προστασίας» είναι το θέμα της θερινής δραστηριότητας για μικρούς και μεγάλους του Μουσείου Φυσικής Ιστορίας Απολιθωμένου Δάσους Λέσβου, στο οποίο μπορούν να συμμετέχουν οι επισκέπτες του Απολιθωμένου Δάσους που θα επισκεφτούν φέτος το καλοκαίρι το Σίγρι της Λέσβου. Το πρόγραμμα θα υλοποιείται για όλο τον Αύγουστο.

Το εκπαιδευτικό πρόγραμμα του Μουσείου «Σεισμοί, τσουνάμι & μέτρα προστασίας» είναι ένα συναρπαστικό ταξίδι στον κόσμο των σεισμών και επικεντρώνεται στην προετοιμασία και τα μέτρα προστασίας πριν, κατά τη διάρκεια και μετά από ένα σεισμό.

Οι συμμετέχοντες γίνονται για λίγο «σεισμολόγοι», και ανακαλύπτουν πληροφορίες για τους σεισμούς, μέσα από ποικίλα εργαλεία και δραστηριότητες με την καθοδήγηση των επιστημόνων του Μουσείου. Έννοιες όπως ρήγματα, τσουνάμι, ρευστοποίηση εδαφών, καθιζήσεις, καταπτώσεις γίνονται περισσότερο κατανοητές και τους γνωρίζουν τις συνέπειες των σεισμών που πολλές φορές είναι πιο καταστροφικές και από τους ίδιους τους σεισμούς.

Καινοτομία του προγράμματος είναι η βιωματική εμπειρία στη σεισμική τράπεζα του Μουσείου. Οι συμμετέχοντες ζουν το μεγάλο σεισμό της Ιαπωνίας καθώς και άλλους ισχυρούς σεισμούς από την Ελλάδα και όλο τον κόσμο, όπως ο σεισμός της Κοζάνης, της Καλιφόρνιας, της Ταιβάν, του Ιράν που έχουν προκαλέσει μεγάλες καταστροφές.

Η εμπειρία της σεισμικής κίνησης στη σεισμική τράπεζα του Μουσείου φέρνει τους συμμετέχοντες σε επαφή με το φαινόμενο του σεισμού και βοηθά στην αποβολή του αισθήματος πανικού. Παράλληλα επιτρέπει να συνειδητοποιήσουν την ανάγκη σωστής προετοιμασίας για την αντιμετώπιση του σεισμικού κινδύνου.

(TRAVELLING NEWS, 4 Αυγούστου 2011)

"Earthquake cushion" could reduce shaking of buildings
Tire-Soil Mixture Buffers From Quakes

University of Hong Kong Researchers Develop Cushion Aimed at Impoverished Markets in Seismic Hot Zones

The damage from the March 11 earthquake in Japan, though devastating, could have been far worse. Thanks to Japan's hefty investment in earthquake-resilient technology—from steel bracing to hydraulic shock absorbers—after the Kobe quake of 1995, many buildings withstood the temblor.

Developing countries, which lack the resources and technology to effectively prepare for earthquakes, are much more vulnerable. However, researchers at the University of Hong Kong have developed a low-cost earthquake "cushion" geared toward impoverished countries situated in seismic hot zones like Pakistan, India and Bangladesh.

The Earthquake Cushion—a finalist in the Asian Innovation Awards—is made of soil and tire chips that form a layer below and around a building's foundation and reduce earthquake shaking by 50% on average, according to the university's in-house computer simulations.

"It's a lot like the airbag in a vehicle, which prevents occupants from striking the interior objects," explains Dr. Hing-Ho Tsang, principal investigator behind the cushion, also called the "Geotechnical Seismic Isolation System."

The cushion acts as a buffer between earthquake waves and a building. The rubber in the cushion attracts seismic waves and damps them. Rubber, known for its energy absorption, is often used for vibration control and to dampen automotive components.

"This is a paradigm shift," said Dr. Tsang, since there is no other earthquake protection technology that operates in this way. The cushion dissipates seismic energy before the waves reach a building's foundation. This differs from the traditional earthquake proofing—like laminated rubber bearings—which are installed between a building and its foundation. As a result, the bearings are a part of the structure and seismic waves can still potentially damage a building before they are dissipated, explained Dr. Tsang.

In the past decade, an average of 60,000 people a year have died from earthquakes. The vast majority was in impoverished countries, the journal Nature reported recently. The 2010 earthquake in Haiti leveled more than 100,000 buildings. The majority of the roughly 300,000 people killed were crushed under the rubble.

That's why "low-cost earthquake protection methods are desperately needed and the earthquake cushion is a promising one," said Dr. Tsang. By using recycled tire shreds, the earthquake cushion costs roughly "5% of total construction costs to install and doesn't require advanced technology," he said.

For example, a three-story building that's 10 meters wide costs roughly $63,000 to build in mainland China. The Earthquake Cushion would cost about an additional $3,100. "This small cost would go toward excavation, deposition and compaction of the rubber-soil mixture," Dr. Tsang said. To install laminated rubber bearings—a more common earthquake-protection method in developed countries—would typically cost 10% of the total construction cost, Dr. Tsang said.

The earthquake cushion is also environmentally friendly since it uses tires that otherwise collect in landfills or are burned. Used tires are banned from landfills in the European Union and several states in the U.S., further fueling the charge to generate alternative uses for the tire stockpile. Each year, about 800 million rubber tires are discarded, with that number expected to grow as car sales increase in emerging markets.

Engineers have long used scrap tires for highway embankments in the U.S., but the impact on local ecology remains the subject of debate. One fear is groundwater contamination as tire chips, like those Dr. Tsang plans to use in his product, leach out manganese and iron. Dr. Tsang responded that manganese is already naturally present in ground water in many areas. The iron-level increase from tire chips is just enough to change the taste of the water, but not enough to become toxic, he said, citing a series of related field and lab studies documented in a 2008 article from the University of Massachusetts, Lowell.

The earthquake cushion is still going through preliminary tests to gauge its effectiveness and safety before it is used on buildings. To date, the university has run computer simulations that track the cushion's performance against actual earthquake models, including the 7.8-magnitude earthquake that struck Chile in 1985. Researchers varied the number of building stories and width of the cushion. In all cases the cushion effectively reduced both horizontal and vertical ground motion by 40%-60%.

Hing-Ho Tsang says the earthquake cushion, made of a mix of recycled tires and soil, could reduce shaking by 50% on average. Above, a specimen of the cushion materials.

Still, some experts question the real-life application of the cushion including Masataka Fukushima, director of Japan Structural Consultants Association. A taller building using an earthquake cushion could still fall during a quake since the cushion does not provide enough support spanning the height of the building, "but if the building is low-rise, it could be OK," he said.

Hong Kong University researchers found the cushion is most effective when it is at least 5 meters thick and used for medium-rise buildings between five and 20 stories. They have not done simulations on buildings taller than this so have not confirmed if there is any limit, said Dr. Tsang.

In 2009, the University of Hong Kong lined up with a research group at Central South University in China to conduct a small-scale shaking table test, simulating the weight of one and two story houses respectively, which confirmed the computer-based results.

The next challenge: conducting enough successful experiments to get the "skeptical construction industry" to accept the innovation, said Dr. Tsang. But, the researcher remains optimistic. "In the past, drivers thought that using seat belts alone is adequate, but nowadays the use of airbags becomes a standard," he said. "New ideas are always met with resistance."

(Linda Blake / The Wall Street Journal, September 7, 2011)

US scientists testing earthquake early warning

PASADENA, Calif. (AP) — Elizabeth Cochran was sitting in her office when her computer suddenly sounded an alarm.

Beep. Beep. Beep.

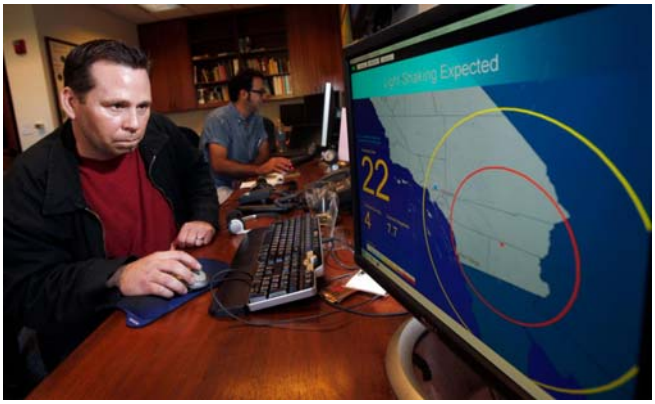
A map of California on her screen lit up with a red dot, signaling an earthquake had struck. A clock next to the map counted down the seconds until shock waves fanning out from the epicenter north of Los Angeles reached her location in Pasadena: 5-4-3-2-1.

Right on cue, Cochran felt her chair quiver ever so slightly from a magnitude-4.2 that rumbled through Southern California on Sept. 1.

"If I hadn't known it was an earthquake, I would have thought it was a truck going by," she said.

After years of lagging behind Japan, Mexico and other quake-prone countries, the U.S. government has been quietly testing an earthquake early warning system in California since February. Cochran belongs to an exclusive club of scientists who receive a heads up every time the state shakes.

The alert system is still crude and messages are not yet broadcast to residents or businesses.



This Sept. 13, 2011 photo shows Anthony Guarino Jr., a seismic analyst at the California Institute of Technology, demonstrating an early earthquake warning system in Pasadena, Calif. The U.S. government has been testing an alert system in California that may someday warn residents and businesses that an earthquake has hit. It's still in the test phase and only about 30 scientists have been handpicked to receive the warnings. The project is headed by the U.S. Geological Survey based on computer code developed by the California Institute of Technology and University of California, Berkeley.

With more testing and funding, researchers hope to build a public warning system similar to the Japanese that has been credited with saving lives during the March 11 magnitude-9 disaster.

Since earthquakes are unpredictable, supporters of early warning say it's the next best thing to prepare people and the commercial sector before the ground rocks. Even a 5-second advance notice can be precious, they contend.

"You want to get under a sturdy table before things start falling off the wall," said University of California, Berkeley seismologist Richard Allen, a project participant. "We don't want people to start running out of buildings."

Early warning is designed to sense the first pulses of energy after a fault breaks and estimate the magnitude based on limited information. This is possible because of the different speeds at which seismic waves travel.

A sprawling web of underground sensors can detect the faster-moving and less damaging primary or "P'' waves before the secondary "S'' waves that can cause buildings to pancake. A warning is issued ahead of the arrival of the stronger waves.

How much warning — a few seconds to tens of seconds — depends on the distance from the epicenter. The farther away, the more lead time.

Project chief Doug Given of the U.S. Geological Survey ticked off actions that can be taken: Trains can be slowed or stopped. Air traffic controllers can halt takeoffs and landings. Power plants and factories can close valves. Schoolchildren can dive under their desks and cover their heads.

Early warning is useless at the quake's origin because the tremors radiate out almost simultaneously.

Japan invested in a public alert system after the deadly 1995 magnitude-6.9 Kobe earthquake. Development began in 2000. Seven years and $500 million later, Japan unveiled the world's first early warning network. Parts of Mexico, Taiwan and Turkey also have embraced early warning, but their systems are less sophisticated.

The Japanese got their big test in March when a massive quake hit off the northeast coast and spawned a tsunami. A public emergency announcement was sent out 8 seconds after sensors detected the first inkling of the quake, interrupting regular TV and radio programming, and buzzing cell phones.

Millions received 5 to 40 seconds of warning depending on how far they were from the epicenter. Tokyo — about 230 miles away — got about 10 to 30 seconds of notice before high-rises swayed. A dozen trains were stopped in their tracks without derailing.

There were glitches. Sensors underestimated the quake at a magnitude-8.1 when it was actually 22 times stronger. Because of the error, warnings were not sent to certain cities. The jolt was so violent that it knocked 55 seismic stations offline and there were no warnings sent for aftershocks for several hours.

Still, in a hearing before a House subcommittee a week after the disaster, USGS director Marcia McNutt told lawmakers the Japanese early warning system saved thousands of lives. McNutt also acknowledged the financial cloud surrounding the U.S. effort.

"Shame on us if we do not learn from their misfortune," she testified.

Since 2006, the U.S. has been testing three alert systems and launched a prototype internally known as "ShakeAlert" in February, a month before the Japan devastation. For now, messages are only blasted out to about 30 scientists at the USGS, California Institute of Technology and University of California, Berkeley, where they are working out software bugs on a shoestring budget.

Where possible, the U.S. has borrowed aspects of Japan's warning system. Researchers said it's not possible to just replicate it because of differences in the countries' seismic sensor networks.

"It's not perfect," said Berkeley's Allen of the U.S. effort. "Frankly, it's stuck together with duct tape, but it's operational."

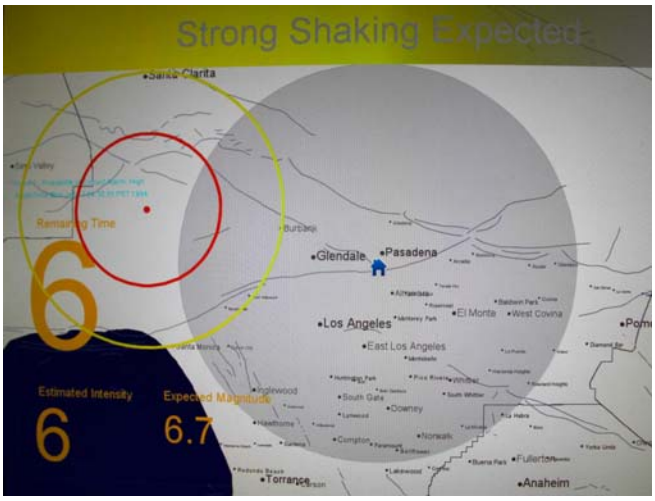
The next steps are to partner with businesses to test the system in the real world later this year and work on a more robust network. The Southern California Earthquake Center, made up of 55 research institutions worldwide, has been chosen to independently rate how it's working.

Technology hurdles aside, the work suffers from lack of funding. The USGS has spent $2 million on the project and is seeking help from private foundations and industry groups. Scientists estimate it will cost $80 million over five years to create a statewide public alert system and millions more annually to maintain it.

"That's tough in this budget environment when there are lots of trade-offs that have to be considered," said David Applegate, associate director for natural hazards at USGS headquarters, adding that he remained hopeful.

It's been a long wait for Caltech engineering professor Tom Heaton, who has studied early warning for more than three

decades and finally got it running in his house on his 60th birthday.



This Sept. 13, 2011 photo shows a demonstration of an early earthquake warning system at the California Instution of Technology in Pasadena, Calif. This computer model displays a replication of the 6.7 magnitude Northridge Earthquake of 1994.

"My hope is that it happens before I die. That's my goal," Heaton said.

To date, the alerts only pop up on the selected scientists' computers, which is an impractical way to warn because it depends upon being online. Scientists envision eventually broadcasting messages through TV, radio and cell phones.

Since the prototype went live, users have hardly felt any shaking because the quakes are either too weak or too distant. Occasionally, they get notice of a jolt that they care about like the magnitude-4.2 centered near Newhall, a bedroom community about 25 miles north of downtown Los Angeles.

Though a mild tremble by seismic standards, it rattled nerves across a wide swath.

Cochran, who recently left the academic world to join the USGS in Pasadena, has been running the program in the background for about a month before the Newhall rumble. She has grown used to the constant pinging whenever the ground heaves. The Newhall quake caught her interest because the countdown was short — a sign that it occurred close by.

So Cochran sat still and waited for the shaking. Had it been stronger, she would have ducked under her desk.

"It was the first time that I had gotten a warning and actually felt it," she said.

(Alicia Chanc / Associated Press Science, Sep 20, 2011)

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Και εγένετο ζωή

Στην αρχαιότερη παραλία της Γης, νέοι υποψήφιοι για τα αρχαιότερα απολιθώματα

Ανάμεσα στους κόκκους άμμου της αρχαιότερης ακτογραμμής που διατηρείται στην επιφάνεια της Γης, παλαιοβιολόγοι ανακάλυψαν σχηματισμούς που φαίνεται ότι είναι τα αρχαιότερα απολιθώματα που έχουν βρεθεί ως σήμερα: μονοκύτταροι οργανισμοί 3,4 δισεκατομμυρίων ετών, οι οποίοι μάλιστα τρέφονταν πιθανότατα με θειάφι.

Η Γη σχηματίστηκε πριν από 4,6 δισεκατομμύρια χρόνια και φαίνεται ότι κατοικήθηκε νωρίς στην ιστορία της: χημικές ενδείξεις υποδεικνύουν ότι οι πρώτοι μικροοργανισμοί εμφανίστηκαν πριν από 3,5 δισεκατομμύρια χρόνια, όταν ακόμα η ατμόσφαιρα δεν περιείχε σχεδόν καθόλου οξυγόνο (το οξυγόνο παράχθηκε πολύ αργότερα από τα φυτά).

Παρά αυτές τις ενδείξεις, όμως, η ανακάλυψη απολιθωμάτων που θα αποδείκνυαν την ύπαρξη αυτών των οργανισμών είναι εξαιρετικά δύσκολη υπόθεση.

Το καλύτερο, ίσως μέρος για την αναζήτηση τέτοιων απολιθωμάτων είναι ο Σχηματισμός Στρέλεϊ στη Δυτική Αυστραλία, μια αρχαία παραλία που σήμερα έχει μετακινηθεί στην ενδοχώρα, Εκεί είχαν βρεθεί το 1980 δομές που θύμιζαν βακτήρια, ηλικίας 3,5 δισ. ετών, οι οποίες όμως αποδείχθηκε τελικά ότι είχαν ανόργανη προέλευση.

Οι βράχοι του Σχηματισμού Στρέλεϊ στην Αυστραλία είναι από τα αρχαιότερα τμήματα του γήινου φλοιού που διατηρούνται ως σήμερα (Πηγή: NASA/Abigail Allwood)

Στην ίδια περιοχή ανακαλύφθηκε τώρα ένας νέος υποψήφιος για τα αρχαιότερα απολιθώματα του κόσμου, ο οποίος παρουσιάζεται στην επιθεώρηση Nature Geoscience.

Οι επίμαχες δομές -σφαιρίδια και ραβδία- έχουν μήκος από 5 έως 80 μικρόμετρα (εκατομμυριοστά του μέτρου), περίπου όσο τα σημερινά βακτήρια. Είναι πλούσια σε άνθρακα και τα τοιχώματά τους έχουν ομοιόμορφο πάχος, χαρακτηριστικά που ενισχύουν την πιθανότητα να μην έχουν ανόργανη προέλευση.

Το ενδιαφέρον είναι ότι μέσα και γύρω από αυτές τις δομές εντοπίστηκαν μικροσκοπικοί κρύσταλλοι θειικού σιδήρου, όπως συμβαίνει και με μερικά σύγχρονα βακτήρια, τα οποία αντλούν ενέργεια από την αναγωγή θειούχων ενώσεων σε θειικές ενώσεις.

Και αυτό αφήνει ανοιχτό το ενδεχόμενο οι πρώτοι κάτοικοι του πλανήτη να τρέφονταν αποκλειστικά με ανόργανες ενώσεις.

(Newsroom ΔΟΛ, 22 Αυγ. 2011)

Nature Geoscience | Letter

Microfossils of sulphur-metabolizing cells in 3.4-billion-year-old rocks of Western Australia

David Wacey, Matt R. Kilburn, Martin Saunders, John Cliff & Martin D. Brasier

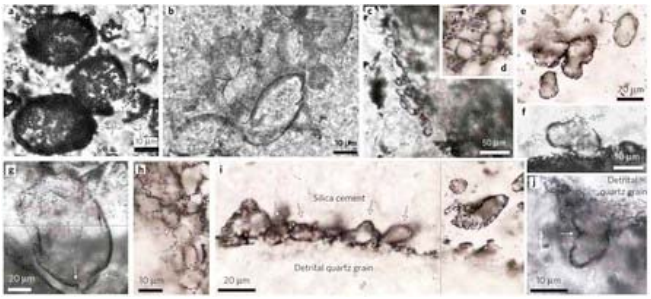
Sulphur isotope data from early Archaean rocks suggest that microbes with metabolisms based on sulphur existed almost 3.5 billion years ago, leading to suggestions that the earliest microbial ecosystems were sulphur-based.

However, morphological evidence for these sulphur-metabolizing bacteria has been elusive. Here we report the presence of microstructures from the 3.4-billion-year-old Strelley Pool Formation in Western Australia that are associated with micrometre-sized pyrite crystals. The microstructures we identify exhibit indicators of biological affinity, including hollow cell lumens, carbonaceous cell walls enriched in nitrogen, taphonomic degradation, organization into chains and clusters, and $\delta^{13}C$ values of −33 to −46‰ Vienna PeeDee Belemnite (VPDB). We therefore identify them as microfossils of spheroidal and ellipsoidal cells and tubular sheaths demonstrating the organization of multiple cells. The associated pyrite crystals have $\Delta^{33}S$ values between −1.65 and +1.43‰ and $\delta^{34}S$ values ranging from

−12 to +6‰ Vienna Canyon Diablo Troilite (VCDT)[5]. We interpret the pyrite crystals as the metabolic by-products of these cells, which would have employed sulphate-reduction and sulphur-disproportion-ation pathways. These micro-fossils are about 200 million years older than previously described microfossils from Palaeoarchaean siliciclastic environments.

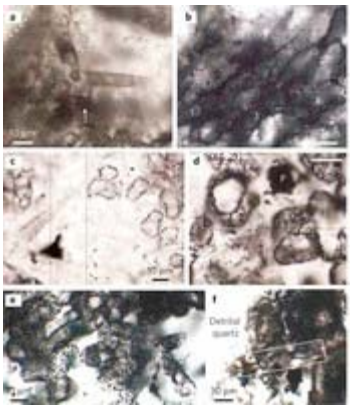
Figures at a glance

Figure 1: Examples of spheroidal/ellipsoidal microfossils from the SPF (samples SP9D2, SPE1, SPV3a–c).close



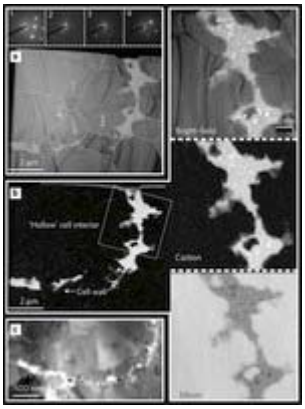
a,**b**,**e**, Clusters of cells, some showing cell wall rupturing (arrows in **a**,**b**), folding or invagination (arrow in **e**). **c**,**d**,**h**, Chains of cells with cellular divisions (arrows). **f**,**i**–**j**, Cells attached to detrital quartz grains, exhibiting cell wall rupturing…

Figure 2: Examples of hollow, tubular, sheath-like microfossils from the SPF (samples SPV3a-c).close



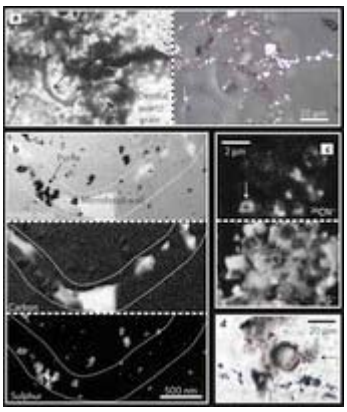
a, Tubes (arrows) extending away from a detrital quartz grain (dashed surface). **b**, Three partially degraded aligned tubes (1–3). **c**, Tube with a split wall (arrow), co-occurring with clusters of spheroidal microfossils. **d**, Montaged transverse cross-se…

Figure 3: Microfossil walls and quartz grain boundaries (sample SPV3b).close



a,**b**, Bright-field- and energy-filtered-TEM images of a partial cell wall (from Fig. 1f). Carbon is confined to the curved cell wall. Multiple micro-quartz grains infill the cell interior, confirmed by selected area electron diffraction patterns (1–4)…

Figure 4: Spatial relationships between microfossils and pyrite (SP9D2a–b, SPV3b).close



a, Partial microfossil walls (black arrows) intermixed with pyrite coating quartz grains. Pyrite (right image, white) occurs as 1–10 μm grains exterior to the microfossils and as nano-grains within microfossil walls (white arrows). **b**, TEM images of a…

(Nature Geoscience, Published online 21 August 2011)

Οι αλγόριθμοι κοντά στην κυριαρχία του κόσμου

Εάν περιμένετε κάποια προειδοποίηση ότι ο υπολογιστής σας έγινε επιτέλους πιο έξυπνος από εσάς, τότε σκεφτείτε το ξανά.

Μην περιμένετε έναν υπερυπολογιστή όπως στην ταινία «2001: Οδύσσεια του Διαστήματος» να σας πληροφορεί ότι οι υπηρεσίες μας ως άνθρωποι έχουν ξεπεραστεί.

Στην πραγματικότητα οι ηλεκτρονικοί ηγεμόνες μας έχουν ήδη πάρει τον έλεγχο και το κάνουν με έναν τρόπο πολύ πιο υπόγειο απ' ότι μας έχει δείξει σήμερα η επιστημονική φαντασία. Το όπλο που έχουν επιλέξει για να μας επιβληθούν είναι οι αλγόριθμοι.

Πίσω από κάθε «έξυπνη» υπηρεσία στο Διαδίκτυο βρίσκεται ένας ακόμη πιο «έξυπνος» κωδικός. Από τους απλούς υπολογισμούς που βρίσκουν ποια βιβλία και ταινίες θα μπορού-

σαν να μας ενδιαφέρουν έως τις υπηρεσίες ανεύρεσης φίλων στο Facebook και τις μηχανές αναζήτησης αυτός ο οδηγός είναι παντού γύρω μας στο Διαδίκτυο. Αυτοί οι αόρατοι υπολογισμοί είναι που αναλαμβάνουν ολοένα και περισσότερο τον έλεγχο στον τρόπο με τον οποίο αλληλεπιδρούμε με τον ηλεκτρονικό μας κόσμο.

Στην εκδήλωση του TEDGlobal που πραγματοποιήθηκε τον προηγούμενο μήνα, ο ειδικός στους αλγόριθμους Κέβιν Σλέιβιν προειδοποίησε ότι «τα μαθηματικά που χρησιμοποιούν οι υπολογιστές για να αποφασίζουν πάνω σε διάφορα θέματα» έχουν «διεισδύσει σε όλους τους τομείς της ζωής μας».

Ως παράδειγμα ανάφερε τα ρομπότ - καθαριστές που σχεδιάζουν τον καλύτερο δυνατό τρόπο για να κάνουν τις δουλειές του σπιτιού και τους διαδικτυακούς εμπορικούς αλγόριθμους που σιγά σιγά αποκτούν τον έλεγχο στη Wall Street. «Γράφουμε εκείνα τα πράγματα που δεν μπορούμε πλέον να διαβάσουμε» τόνισε ο κ. Σλέβιν και πρόσθεσε: «Καταστήσαμε κάτι δύσκολο να διαβάσουμε. Χάσαμε την αίσθηση του τι πραγματικά συμβαίνει σε αυτό τον κόσμο που κατασκευάσαμε».

«Μπορεί οι υπολογιστές να είναι πιο έξυπνοι από τους ανθρώπους ωστόσο δεν έχουν την ίδια αίσθηση της προοπτικής και αυτό έγινε σαφές στον κώδικα θέσπισης τιμών στην Amazon, ώστε ο κώδικας να κηρύξει πόλεμο στον εαυτό του, ένα επεισόδιο που συνέβη μόλις πριν λίγους μήνες» επεσήμανε ο κ. Σλέβιν.

Όσο περισσότερο εξελίσσεται ένας κώδικας, τόσο εξαπλώνεται σε όλους τους τομείς της ζωής μας, συμπεριλαμβανομένου των πολιτισμικών μας προτιμήσεων.

Ο αλγόριθμος που χρησιμοποιείται στην ιστοσελίδα Netflix, όπου νοικιάζονται ταινίες, είναι υπεύθυνος για το 60% των ενοικιάσεων, ενώ μειώνεται όλο και περισσότερο η κριτική μας ικανότητα και η διάδοση από στόμα σε στόμα αυτού του φαινομένου που ο κ. Σλέιβιν αποκαλεί «φυσική του πολιτισμού».

Η βρετανική εταιρεία Epagogix χρησιμοποιεί αυτή την ιδέα, αλγόριθμους που προβλέπουν ποια είναι η συνταγή μίας επιτυχημένης ταινίας.

Χρησιμοποιεί διάφορες μετρήσεις - το σενάριο, η πλοκή, οι σταρ και η τοποθεσία - τα αναμειγνύει και τα συγκρίνει με άλλες ταινίες που έχουν πετύχει και την πορεία τους στα ταμεία, προκειμένου να προβλέψει πόσα λεφτά θα βγάλει η ταινία.

Σύμφωνα με τον διευθυντή της Epagogix Νικ Μέινι, το σύστημα αυτό «βοήθησε τα στούντιο να αποφασίσουν αν θα κάνουν μία ταινία ή όχι».

Σε μία περίπτωση για μία ταινία με κόστος παραγωγής 180 εκατομμυρίων λιρών, ο αλγόριθμος προέβλεψε ότι θα έφερνε μόλις 30 εκατομμύρια λίρες στα ταμεία με αποτέλεσμα το πρότζεκτ να ακυρωθεί.

Για μία άλλη ταινία ο αλγόριθμος βρήκε ότι τα κέρδη θα ήταν τα ίδια εάν τον γυναικείο πρωταγωνιστικό ρόλο αναλάμβανε η ακριβοπληρωμένη σταρ ή μία απλή και πιο φθηνή ηθοποιός.

Είναι μία «κλινική» προσέγγιση για τη δημιουργία μίας ταινίας που ενόχλησε πολλούς που πιστεύουν ότι θα πρέπει να είναι μία πιο δημιουργική διαδικασία.

Η μυστική συνταγή

Ο πρώτος και μεγαλύτερος σταρ των αλγόριθμων είναι η Google. Ο διάσημος μυστικός κώδικας οδήγησε την εταιρεία στην πρωτιά και σήμερα είναι από τις πιο ισχυρές στον κόσμο.

Κανείς δεν αμφισβητεί ότι το σύστημα της εταιρείας έχει κάνει τη διαδικτυακή αναζήτηση πιο εύκολη, ωστόσο οι επικριτές αναρωτιούνται ποιο είναι το κόστος.

Στο βιβλίο του «Η φούσκα του φίλτραρίσματος», ο Έλι Παρίζερ αναρωτιέται σε ποιο βαθμό ο αλγόριθμος της Google έχει χρησιμοποιήσει τα προσωπικά μας δεδομένα προκειμένου να διαμορφώσει αυτό που βλέπουμε στο Διαδίκτυο σύμφωνα με τις προσωπικές μας προτιμήσεις.

Εν τω μεταξύ, μία πρόσφατη έρευνα ψυχολόγων στο Πανεπιστήμιο Κολούμπια υποδεικνύει ότι σταδιακά αλλάζει ο τρόπος που σκέφτονται οι άνθρωποι καθώς αυξάνεται η εξάρτησή μας από τις μηχανές αναζήτησης για να βρούμε μία απάντηση.

«Από τη δημιουργία των μηχανών αναζήτησης, έχουμε αναδιοργανώσει τον τρόπο με τον οποίο θυμόμαστε. Οι εγκέφαλοί μας βασίζονται στο Διαδίκτυο τη μνήμη τους με τον ίδιο τρόπο που βασίζονται στη μνήμη ενός φίλους, ενός συγγενή ή ενός συνεργάτη» αναφέρει η συγγραφέας της έκθεσης, Μπέτσι Σπάροου και υπογραμμίζει: «Όσο περνάει ο καιρός, γνωρίζουμε που μπορούμε να βρούμε πληροφορίες απ' ότι να τις διατηρούμε εμείς οι ίδιοι».

Αλλά και στις χρηματιστηριακές αγορές, ο κώδικας κυριαρχεί καθώς προσπαθούμε να ελέγξουμε τους αλγόριθμους που υπολογίζουν και αποφασίζουν τι να αγοράσουμε και τι όχι.

Σχεδόν το 70% των συναλλαγών στη Wall Street πραγματοποιούνται μέσω του «μαύρου κουτιού» ή αλλιώς των αλγοριθμικών συναλλαγών.

Αυτό σημαίνει ότι μαζί με τους χρηματιστές και τους τραπεζίτες εργάζονται πλέον χιλιάδες μαθηματικοί και φυσικοί.

Αλλά ακόμη και μία πρόβλεψη από έναν αλγόριθμο, που υποστηρίζεται σε κώδικες που δημιουργούν οι άνθρωποι, δεν εξασφαλίζουν ότι όλα θα κυλήσουν ομαλά.

Αυτό συνέβη στις 6 Μαΐου 2010 όταν στις 14:45 προκλήθηκε ένα ψηφιακό κραχ, που οδήγησε τις αγορές σε ελεύθερη πτώση για πέντε λεπτά και δημιουργώντας ένα προσωρινό χάος. Υπαίτιος ήταν ο αλγόριθμος που χρησιμοποιούσε ένας χρησιμοποιούσε ένας χρηματιστής. Ο αλγόριθμος πούλησε 75.000 μετοχές αξίας 2,6 δισεκ. Λιρών σε μόλις 20 λεπτά, προκαλώντας τους υπόλοιπους αλγόριθμους να ακολουθήσουν.

Οι αλγόριθμοι είναι σας τους χρηματιστές στη Wall Street τη δεκαετία του 1980 χωρίς όμως να έχουν απαιτήσεις σε μισθούς, δώρα και σαμπάνιες.

Στις ΗΠΑ η εταιρεία Spread Networks τοποθετεί ένα καλώδιο οπτικών ινών, που θα συνδέει το Σικάγο με τη Νέα Υόρκη (1327 χλμ.) και θα ελαττώσει το χρόνο των συναλλαγών κατά 3 δέκατα του δευτερολέπτου.

Εν τω μεταξύ, ετοιμάζεται και η σύνδεση οπτικών ινών μεταξύ της Νέας Σκωτίας στον Καναδά και του Σόμερσετ στη Βρετανία, που θα εξυπηρετεί τους αλγοριθμικούς χρηματιστές, οι οποίοι θα στέλνουν μετοχές από το Λονδίνο στη Νέα Υόρκη και πάλι πίσω σε μόλις 60 χιλιοστά του δευτερολέπτου.

Καθώς οι αλγόριθμοι εξαπλώνουν την επιρροή μας πέρα από τις μηχανές και διαμορφώνουν το περιβάλλον γύρω τους, ίσως έχει έρθει ο καιρός να μάθουμε πόσα ακριβώς γνωρίζουν και εάν έχουμε ακόμη τον χρόνο να τους τιθασεύουμε.

(www.kathimerini.gr, 23-08-11 με πληροφορίες από BBC)

Continuously reinforced concrete pavement to enhance Calif. highway

STOCKTON - Not all roads are created equal, and the $122.1 million project to improve Interstate 5 is building a type of surface that is rare in California and expected to last a long time.

Made from concrete reinforced with steel, the new pavement is estimated to last 40 years, according to the California Department of Transportation.

It's a concrete road, not asphalt, but that's not what makes it different.

Concrete roads in the state are more commonly built with breaks - called joints - that help keep the surface from cracking as the concrete changes shape. Using reinforcing steel makes this project different.

"It's one, continuous smooth pour," said Martha Dadala, design manager with Rajappan and Meyer, a San Jose engineering company working on the project. "There are no joints, so it is a smooth ride."

A concrete road with no joints will crack, and so will concrete roads reinforced with steel, said John T. Harvey, director of the University of California Pavement Research Center. But that's not necessarily a bad thing, he said.

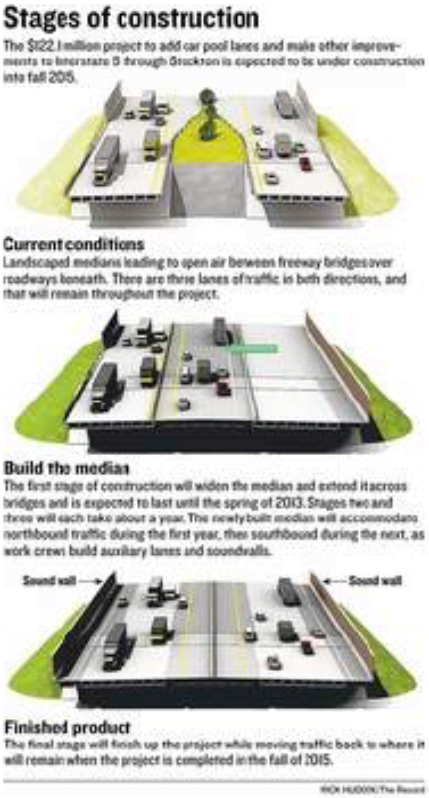
"The steel holds the cracks really tight and close," he said. "It makes the cracks not a problem."

The type of roadway - known as "continuously reinforced concrete pavement" - is in wider use outside of California.

It took off elsewhere, because road building started earlier in California - before the advancement of the technology made this method a sure thing. "It's a high-reward, high-risk pavement," Harvey said. "If you build it wrong, you don't get long life."

In 1948, an experimental section of the type of concrete road was built by the city of Fairfield on what is now Interstate 80, Harvey said. It was taken out two years ago. "That was a very long time with some very smooth pavement."

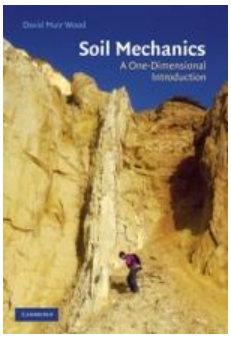
If the I-5 pavement is built right, it will stay smooth for a long time, too, he said. And a long life, with a low cost for upkeep, is what transportation officials expect.



"The intent is we see very minimal, low-impact maintenance," Caltrans project manager Scott Guidi said.

(The Record (Stockton, Calif.), September 19, 2011)

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



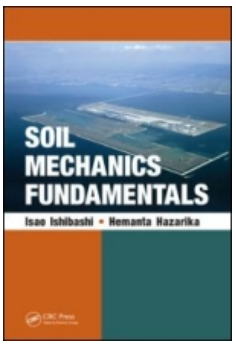
Soil Mechanics: A One-Dimensional Introduction

David Muir Wood

This book teaches the principles of soil mechanics to undergraduates, along with other properties of engineering materials, to which the students are exposed simultaneously. Using the critical state method of soil mechanics to study the mechanical behavior of soils requires the student to consider density alongside effective stresses, permitting the unification of deformation and strength characteristics. This unification aids the understanding of soil mechanics. This book explores a one-dimensional theme for the presentation of many of the key concepts of soil mechanics - density, stress, stiffness, strength, and fluid flow - and includes a chapter on the analysis of one-dimensional consolidation, which fits nicely with the theme of the book. It also presents some theoretical analyses of soil-structure interaction, which can be analyzed using essentially one-dimensional governing equations. Examples are given at the end of most chapters, and suggestions for laboratory exercises or demonstrations are given.

• This book tries to integrate soil mechanics teaching with the teaching of other elementary civil engineering subjects • The book introduces critical state ideas in order to emphasize the importance of volume change and density in soils • The book includes a chapter on soil-structure interaction as an integrating subject which is often neglected in civil engineering degree programs.

(Cambridge University Press, 30.11.2010)



Soil Mechanics Fundamentals

Isao Ishibashi, Hemanta Hazarika

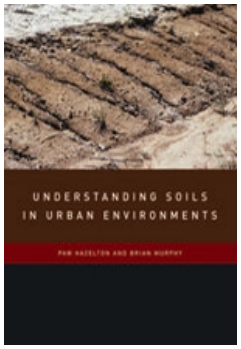
While many introductory texts on soil mechanics are available, most are either lacking in their explanations of soil behavior or provide far too much information without cogent organization. More significantly, few of those texts go beyond memorization of equations and numbers to provide a practical understanding of why and how soil mechanics work.

Based on the authors' more than 25 years of teaching soil mechanics to engineering students, **Soil Mechanics Fundamentals** presents a comprehensive introduction to soil mechanics, with emphasis on the engineering significance of *what soil is*, *how it behaves*, and *why it behaves that way*. Concise, yet thorough, the text is organized incrementally, with earlier sections serving as the foundation for more advanced topics. Explaining the varied behavior of soils through mathematics, physics and chemistry, the text covers:

- Engineering behavior of clays
- Unified and AASHTO soil classification systems
- Compaction techniques, water flow and effective stress
- Stress increments in soil mass and settlement problems
- Mohr's Circle application to soil mechanics and shear strength
- Lateral earth pressure and bearing capacity theories

Each chapter is accompanied by example and practicing problems that encourage readers to apply learned concepts to applications with a full understanding of soil behavior fundamentals. With this text, engineering professionals as well as students can confidently determine logical and innovative solutions to challenging situations.

(CRC Press, 13.12.2010)



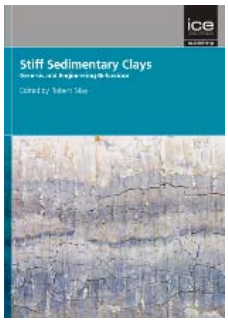
Understanding Soils in Urban Environments

Pam Hazelton and Brian Murphy

Soil properties such as water retention, salinity and acidity are not just issues for agriculture and forestry. They are equally as significant in creating environmental and structural problems for buildings and other engineering works. As a greater proportion of the world's population is now living in cities, and building and related infrastructure development continues, these problems assume ever-greater importance. In addition, existing works contribute to urban soil erosion and pollution as well as increased levels of urban runoff.

This book explains how urban soils develop, change and erode. It describes their physical and chemical properties and focuses on the specific soil properties that can cause environmental concern and also affect engineering works. It also addresses contemporary issues such as green roofs, urban green space and the man-made urban soils that these may need to thrive in. It provides a concise introduction to all aspects of soils in urban environments and will be extremely useful to students in a wide range of disciplines from soil science and urban forestry and horticulture, to planning, engineering, construction and land remediation.

(Earthscan, 08.02.2011)



Stiff Sedimentary Clays: Genesis and engineering behaviour

Edited by Robert May

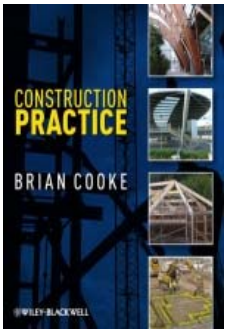
Many major cities are built on stiff sedimentary clays and the increasing demands for large earthworks, major foundations, deep excavations and tunnels, often in close proximity with each other, stretches

our scientific understanding and engineering skills to their limits.

The fourteenth Géotechnique Symposium in Print, returned to geo-materials, focusing on the genesis and engineering behaviour of stiff sedimentary clays and was divided into four sessions – Formation and engineering geology of stiff clays; Laboratory and in situ techniques and their interpretation; Engineering characterisation of stiff clay formations and material models; and Engineering in stiff clays.

This book includes all the related papers, by leading international researchers, published in Géotechnique along with keynote speeches, informal discussions on key submissions that were presented at the Symposium at the Institution of Civil Engineers on 14 May 2007 and additional papers, published in Géotechnique between 2000 and 2006, which add further insights on the major topics of the Symposium.

(ICE Bookshop, 24.02.2011)



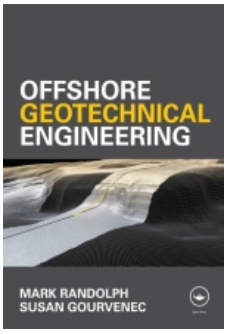
Construction Practice

Brian Cooke

Construction is a highly practical subject. Students on all built environment degree programmes are expected to know and understand building technology from both a theoretical and practical standpoint. Construction site visits are a popular way for students to become acquainted with the practical aspects of construction, but these visits can only show students a small proportion of the technology of construction.

Based around a series of full colour photographic sequences, augmented by carefully chosen line illustrations and text, **Construction Practice** provides students with a comprehensive overview of practical construction technology. The sequences follow a logical progression through the subject and include contemporary and established practice, as well as modern methods of construction. The book also includes some examples of continental European construction methods where these differ from established UK practice.

(Wiley-Blackwell, 04.03.2011)



Offshore Geotechnical Engineering

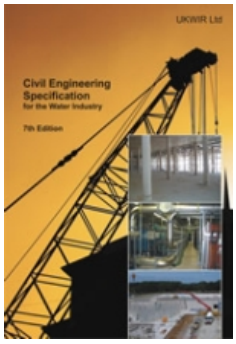
Mark Randolph and Susan Gourvenec

Design practice in offshore geotechnical engineering has grown out of onshore practice, but the two application areas have tended to diverge over the last thirty years, driven partly by the scale of the foundation and anchoring elements used offshore, and partly by fundamental differences in construction and installation techniques. As a consequence offshore geotechnical engineering has grown as a speciality.

The structure of Offshore Geotechnical Engineering follows a pattern that mimics the flow of a typical offshore project. In the early chapters it provides a brief overview of the marine environment, offshore site investigation techniques and interpretation of soil behaviour. It proceeds to cover geotechnical design of piled foundations, shallow foundations and anchoring systems. Three topics are then covered which require a more multi-disciplinary approach: the design of mobile drilling rigs, pipelines and geohazards.

This book serves as a framework for undergraduate and postgraduate courses, and will appeal to professional engineers specialising in the offshore industry.

(Spon Press, 18.03.2011)



Civil Engineering Specification for the Water Industry, 7th Edition. (CESWI)

UKWIR (United Kingdom Water Industry Research) LTD

This is the Specification for use in all civil engineering contracts let by Water Undertakers in England, Wales, Scotland and Northern Ireland. It supersedes the Sixth Edition (2004) and reflects the water industry's requirement for comprehensive, universal and relevant specifications for civil engineering contracts.

The Specification is based on performance requirements allowing the Contractor to decide upon his method of working. This 7th edition has been rewritten to reflect the experience of the UK Water Industry and the contractors since the last edition was published, and includes new standards and working practices, together with new technologies and more sustainable options.

The eleven sections of the documents are the same, any additions or changes have been incorporated into these sections.

(UKWIR, 30.03.2011)

ICE Manual of Geotechnical Engineering

J. Burland, T. Chapman, H. Skinner and M. Brown

Written and edited by a wide selection of leading specialists, *ICE Manual of Geotechnical Engineering* delivers an authoritative and comprehensive reference providing the core geotechnical engineering principles, practical techniques, and the major questions engineers should keep in mind when dealing with real-world engineering challenges – all within a consistently coherent framework.

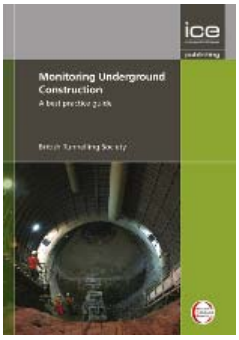
Volume 1 Geotechnical Engineering Principles, Problematic Soils and Site Investigation

This volume tackles the principles and provides a solid grounding in the discipline. Furthermore this volume covers assessment of the ground and soil properties and issues.

Volume 2 Geotechnical Design, Construction and Verification

This volume looks at how to apply geotechnical knowledge in the construction process; tackling onsite, practical situations, including design.

(ICE Publishing, 21.11.2011)



Monitoring Underground Construction

British Tunnelling Society

Monitoring Underground Construction is the only guide to the principles for development, design, implementation and management of monitoring systems employed to manage risks in underground construction for clients, project managers, designers, contractors and asset owners.

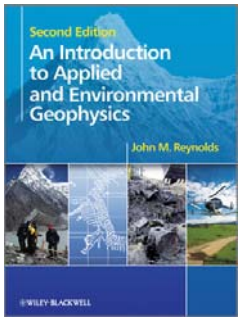
Monitoring is often a key risk mitigation measure for the control of construction processes and protection of existing assets affected by excavations. *Monitoring Underground Construction* is structured to reflect the main stages in a project, from objective setting to operation and management, and highlights the roles and responsibilities of the various stakeholders at each stage to help the reader avoid problems which have historically arisen due to omissions in these areas. Case studies from a range of projects are included to highlight the critical role of strategic and well-planned monitoring programmes in the success of any underground construction project.

Approaching the subject at the level of key principles, focusing on setting objectives, strategic planning and the high level specification of monitoring systems, and based on experience gained across a variety of projects, *Monitoring Underground Construction:*

- is applicable to all underground works whatever their scale or global location
- assists users in managing particular monitoring-related risks that occur at each stage
- discusses the integration of monitoring information with works progress data to facilitate interpretation and management
- covers monitoring undertaken for a range of different objectives and on behalf of various stakeholders
- includes summary checklists for each stage of the project.

Providing best practice guidance on the use of monitoring systems, *Monitoring Underground Construction* is relevant to all those with responsibilities for activities of this type, including clients, project managers, designers and contractors. The guide is also a useful reference for third parties such as insurers and owners or managers of adjacent infrastructure, who have an interest in underground works.

(ICE Publishing, 07.10.2011)



An Introduction to Applied and Environmental Geophysics, 2nd Edition

John M. Reynolds

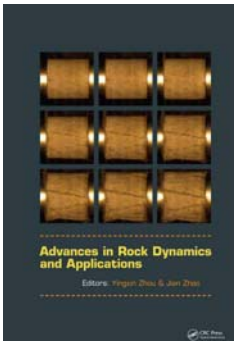
An Introduction to Applied and Environmental Geophysics, 2nd Edition, describes the rapidly developing field of near-surface geophysics. The book covers a range of applications including mineral, hy-drocarbon and groundwater exploration, and emphasises the use of geophysics in civil engineering and in environ-mental investigations. Following on from the international popularity of the first edition, this new, revised, and much expanded edition contains additional case histories, and de-scriptions of geophysical techniques not previously included in such textbooks.

The level of mathematics and physics is deliberately kept to a minimum but is described qualitatively within the text. Relevant mathematical expressions are separated into boxes to supplement the text. The book is profusely illustrated with many figures, photographs and line drawings, many never previously published. Key source literature is provided in an extensive reference section; a list of web addresses for key organisations is also given in an appendix as a valuable additional resource.

- Covers new techniques such as Magnetic Resonance Sounding, Controlled- Source EM, shear-wave seismic refraction, and airborne gravity and EM techniques
- Now includes radioactivity surveying and more discussions of down-hole geophysical methods; hydrographic and Sub-Bottom Profiling surveying; and UneXploded Ordnance detection
- Expanded to include more forensic, archaeological, glaciological, agricultural and bio-geophysical applications
- Includes more information on physio-chemical properties of geological, engineering and environmental materials
- Takes a fully global approach
- Companion website with additional resources available at www.wiley.com/go/reynolds/introduction2e
- Accessible core textbook for undergraduates as well as an ideal reference for industry professionals

The second edition is ideal for students wanting a broad introduction to the subject and is also designed for practising civil and geotechnical engineers, geologists, archaeologists and environmental scientists who need an overview of modern geophysical methods relevant to their discipline. While the first edition was the first textbook to provide such a comprehensive coverage of environmental geophysics, the second edition is even more far ranging in terms of techniques, applications and case histories.

(WILEY-BLACKWELL, April 2011)



Advances in Rock Dynamics and Applications

Yingxin Zhou and Jian Zhao (Editors)

The study of rock dynamics is important because many rock mechanics and rock engineering problems involve dynamic loading ranging from earthquakes to vibrations and explosions. The subject deals with the distribution and propagation of loads, dynamic responses and processes of rocks and rate-dependent properties, coupled with the physical environment. Rock dynamics has a wide range of applications in civil, mining, geological and environmental engineering. However, due to the additional "4th" dimension of time, rock dynamics remains, in the discipline of rock mechanics, a relatively more challenging topic to understand and to apply, where documented research and knowledge are limited.

Advances in Rock Dynamics and Applications was published by CRC Press and provides a summary of the state of the art in rock dynamics with 18 chapters contributed by individual authors from both academia and engineering fields. The topics of this book are wide-ranging and representative, covering fundamental theories of fracture dynamics and wave propagation, rock dynamic properties and testing methods, numerical modelling of rock dynamic failure, engineering applications in earthquakes, explosion loading and tunnel response, as well as dynamic rock support.

- Provides a summary of the state-of-the-art in rock dynamics with the current knowledge of rock dynamics for researchers and engineers.
- The topics chosen are wide-ranging, covering fundamental theories of fracture dynamics and wave propagation, rock dynamic properties and testing methods, numerical modelling of rock dynamic failure, engineering applications in earthquakes, explosion loading and tunnel response, as well as dynamic rock support

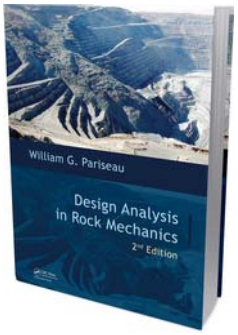
This book is partially a result of the work of the ISRM Commission on Rock Dynamics chaired by Dr Yingxin Zhou.

CRC is offering a discount of 15% for all ISRM members and attendees of the ISRM 12th International Congress on Rock Mechanics, October 18-21, 2011, Beijing, China. Interested readers can use the order form in the leaflet (click here to download), or go to www.crcpress.com, select the book and enter the promocode 476GB at checkout to receive 15% off their purchase. The offer is valid until 31 December 2011.

Book Contents:

1. Introduction
2. An overview of some recent progress in rock dynamics research
3. Split Hopkinson pressure bar tests of rocks: Advances in experimental techniques and applications to rock strength and facture
4. Modified Hopkinson bar technologies applied to the high strain rate rock tests
5. Wave shaping by special shaped striker in SHPB tests
6. Laboratory compressive and tensile testing of rock dynamic properties
7. Penetration and perforation of rock targets by hard projectiles
8. Incubation time based fracture mechanics and optimization of energy input in the fracture process of rocks
9. Discontinuous approaches of wave propagation across rock joints
10. Equivalent medium model with virtual wave source method for wave propagation analysis in jointed rock masses
11. Polycrystalline model for heterogeneous rock based on smoothed particle hydrodynamics method
12. Finite Element Method modeling of rock dynamic failure
13. Discontinuum-based numerical modeling of rock dynamic fracturing and failure
14. Manifold and advanced numerical techniques for discontinuous dynamic computations
15. Earthquakes as a rock dynamic problem and their effects on rock engineering structures
16. Constraining paleoseismic PGA using numerical analysis of structural failures in historic masonry structures: Review of recent results
17. Explosion loading and tunnel response
18. Rock support for underground excavations subjected to dynamic loads and failure

(CRC Press / Balkema, 2011)



Design Analysis in Rock Mechanics, Second Edition

William G. Pariseau

This comprehensive introduction to rock mechanics treats the basics of rock mechanics in a clear and straightforward manner and discusses important design problems in terms of the mechanics of materials. Numerous exercises and examples familiarize the reader with solving basic practical problems in rock mechanics through various design analysis techniques and their applications. A large selection of problems at the end of each chapter are available for home assignment, and a course instructor's solution manual is available for home assignments that may be selected from the extensive list of problems given at the end of each chapter.

Explanatory and illustrative in character, this book is an ideal course book in rock mechanics for undergraduate and first year graduate students in mining and civil engineering and a useful introduction to rock mechanics for earth scientists and engineers from other disciplines.

In this second edition important design problems are discussed from a mechanics of materials approach. Numerous exercises and examples familiarize the reader with solving

practical problems in rock mechanics through various design analysis techniques and their applications.

Major applications addressed are:

- rock slope stability in surface excavations, from planar block and wedge slides to rotational and toppling failures
- shaft and tunnel stability, ranging from naturally-supported openings to analysis and design of artificial support and reinforcement systems
- entries and pillars in stratified ground
- three-dimensional caverns, with emphasis on cable bolting and backfill
- geometry and forces of chimney caving, combination support and trough subsidence
- rock bursts and bumps in underground excavations, with focus on dynamic phenomena and on fast and sometimes catastrophic failures.

Supporting the main text, appendices provide supplementary information about rock, joint, and composite properties, rock mass classification schemes, useful formulas, and an extensive literature list.

Explanatory and illustrative in character, this book is an ideal text in rock mechanics applications for undergraduate and first year graduate students in mining, geological, and civil engineering and a useful introduction to rock mechanics for earth scientists and engineers from other disciplines.

(CRC Press, September 29, 2011)

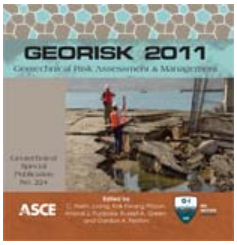
The ITA Contractual Framework Checklist for Subsurface Construction Contracts

This document identifies the key contractual practice areas the ITA believes are fundamental for ensuring the success of subsurface construction projects.

The reason that this document has been prepared is because existing standard forms of construction guidelines and contracts do not adequately deal with the particularities of the subsurface environment. The ITA believes that the application of this framework will enhance the possibility of achieving the project objectives for all stakeholders.

This publication does not specify how each subject area should be resolved, for that is almost certainly a matter peculiar to each project – but recommends that the timely and appropriate consideration of all the matters raised in this publication is essential for the successful subsurface project delivery.

(μπορείτε να «κατεβάσετε» την έκθεση από την ηλ.δι. http://www.ita-aites.org/fileadmin/filemounts/general/pdf/ItaAssociation/ProductAndPublication/WorkingGroupsPublication/WG3/ITA_Report_N6_WG3_P.pdf)



GeoRisk 2011

Geotechnical Risk Assessment and Management

Geotechnical Special Publication (GSP) 224

Juang, C.H., Phoon, K.K., Puppala, A.J., Gree, R.A. and Fenton, G.A. (Editors)

Proceedings of GeoRisk 2011: Geotechnical Risk Assessment and Management, held in Atlanta, Georgia, June 26-28, 2011. Sponsored by the Geo-Institute of ASCE.

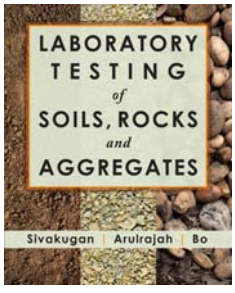
This Geotechnical Special Publication contains 127 peer-reviewed papers that address uncertainties in the geologic environment, covering new and continuing work on geo-hazard mitigation, uncertainty modeling, and risk assessment and management.

Topics include:

- characterization and modeling of variability of soils across scales;
- earth structures/slopes;
- earthquake engineering and soil dynamics;
- engineering geology and site characterization;
- geotechnical assessment, characterization, and design for risk management;
- hazards/risks;
- limit state design in geotechnical engineering;
- load and resistance factor design (LRFD) for foundation systems;
- probabilistic/simulation methods;
- quantitative risk analysis for embankments, dams, and slopes;
- retaining structures;
- risk and reliability in geoenvironmental engineering;
- uncertainty analysis; and
- uncertainty modeling.

This collection offers researchers and practitioners in all fields of geotechnical engineering essential information on identifying and managing risks.

(ASCE Press, 2011)



Laboratory Testing of Soils, Rocks and Aggregates

N. Sivakugan, A. Arulrajah and M.W. Bo

Testing rocks and aggregates are rarely covered in soil testing books and there are no separate books on rock or aggregate testing. Laboratory Testing of Soils, Rocks and Aggregates includes laboratory testing methods for most tests for soils as well as rocks and aggregates, which are becoming increasingly common in professional practice and university teaching. Part A gives a general overview of laboratory measurements, equipment, units, safety and standards. Part B covers soil tests from grain size distribution to consolidation, triaxial and direct shear tests. Part C covers rock tests, which includes the indirect

tensile strength test and point load test. Part D covers the common tests carried out routinely on aggregates, which includes the aggregate impact value test and Los Angeles abrasion test. Each test consists of the following descriptive parts: Objective, Standards, Introduction, Procedure, and Cost. References are made to ASTM International (ASTM), Australian (AS), British (BS) and International Society of Rock Mechanics (ISRM) standards and any differences are noted.

Key Features:

- Contains virtually all current laboratory tests for soils, rocks and aggregates in one volume
- Presents the tests with the most concise and reader-friendly explanation possible, but in adequate detail for both professionals and students
- Includes references to international standards: ASTM, ISRM, BS, and AS
- The authors are practicing consulting engineers as well as university professors – Dr. Sivakugan is the author of the best-selling book, Geotechnical Engineering: A Practical Problem Solving Approach
- WAV offers downloadable spreadsheets that can be used to develop laboratory specific datasheets and easily modified to your style available from the Web Added Value Download Resource Center at www.jrosspub.com

(J. ROSS Publishing, July 2011)

Recommendations for Design and Analysis of Earth Structures using Geosynthetic Reinforcements - EBGEO

Deutsche Gesellschaft für Geotechnik e.V. (ed.)

The Recommendations deal with analysis principles and the applications of geosynthetics used for reinforcement purposes in a range of foundation systems, ground improvement measures, highways engineering projects, in slopes and retaining structures, and in landfill engineering.

The completely revised and extended Recommendations deal with all questions relevant to the planning and dimensioning of geosynthetics-reinforced earth structures. In addition to the demands on materials and analysis principles, the applications of geosynthetics in a range of foundation systems, ground improvement measures, highways engineering projects, in slopes and retaining structures, and in landfill engineering are discussed.

The Recommendations have been supplemented by the following sections:

- reinforced earth structures over point or linear bearing elements,
- foundation systems using geotextile-encased columns,
- bridging subsidence,
- dynamic actions of geosynthetic-reinforced systems.

The remaining sections have been fundamentally revised and updated in line with current standards and codes of practice.

(Ernst & Sohn, April 2011)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

http://www.issmge.org/web/page.aspx?refid=742

http://www.issmge.org/web/page.aspx?refid=755

Κυκλοφόρησαν το 30 και 4ο Τεύχος του 5ου Τόμου του ISSMGE Bulletin (Ιουνίου και Αυγούστου 2011) με ενδιαφέροντα νέα από την διεθνή γεωτεχνική κοινότητα και άρθρα για τον τρίτο μεγάλο σεισμό της Νέας Ζηλανδίας και για τους εορτασμούς των 75 χρόνων από την ίδρυση της ISSMGE, καθώς και το πολύ ενδιαφέρον άρθρο «An approach for poverty reduction by maintaining rural roads in developing countries»

www.geoengineer.org

Κυκλοφόρησαν τα Τεύχη #78, #79 και #80 του **Newsletter του Geoengineer.org** (Μάιος, Ιούνιος και Σεπτέμβριος 2011) με πολλές χρήσιμες πληροφορίες για όλα τα θέματα της γεωτεχνικής μηχανικής. Υπενθυμίζεται ότι το Newsletter εκδίδεται από τον συνάδελφο και μέλος της ΕΕΕΕΓΜ Δημήτρη Ζέκκο (secretariat@geoengineer.org).

No. 15 - September 2011
http://www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=65&ver=1

Κυκλοφόρησε το Τεύχος 15 / Σεπτέμβιος 2011 του Newsletter της International Society for Rock Mechanics.

INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION
ita@news n°40
http://ita-aites.org/index.php?id=812&no_cache=1

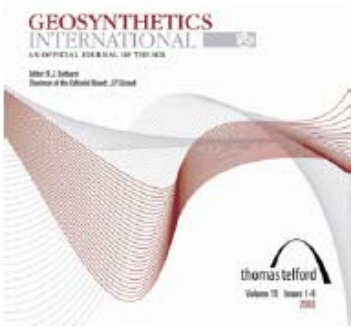
Κυκλοφόρησε το Τεύχος No. 40 – Ιούλιος 2011 των ita@news της International Tunnelling Association.

http://www.itacet.org/Newsletter/03_2011/newsletter_3_2011.php

Κυκλοφόρησε το Τεύχος No. 8 (Ιούλιος 2011) του ITACET Foundation.

http://library.constantcontact.com/download/get/file/1103777414955-79/2011-07-igs-news-f2a.pdf

Κυκλοφόρησε το Τεύχος 2, Volume 27 των IGS News με πληροφορίες για την δραστηριότητα της IGS και τψν εθνικών ενώσεων μελών της.



Geosynthetics International

www.thomastelford.com/journals

Κυκλοφόρησαν τα τεύχη αρ. 2 και 3 του 18ου τόμου (Απριλίου και Ιουνίου 2011) του περιοδικού Geosynthetics International. Πρόσβαση μέσω των ιστοσελίδων http://www.icevirtuallibrary.com/content/issue/gein/18/2 και http://www.icevirtuallibrary.com/content/issue/gein/18/3 αντίστοιχα.

Geotextiles & Geomembranes

www.geosyntheticssociety.org/journals.htm

Κυκλοφόρησαν τα τεύχη αρ. 2, 3 και 4 του 29ου τόμου (Απριλίου, Ιουνίου και Αυγούστου 2011) του περιοδικού Geotextiles & Geomembranes. Πρόσβαση μέσω της ιστοσελίδας www.sciencedirect.com/science/journal/02661144.

ΕΕΕΕΓΜ
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