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ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

179

Η σιδηροδρομική γραμμή Αθηνών – Θεσσαλονίκης (γαιοκατασκευή) μετά τον Daniel

(https://ypodomes.com/sidirodromos-vivlikes-eikones-katastrofis-sto-diktyo-tis-thessalias-apo-tin-kakokairia-daniel-oi-protes-foto)

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

Αποτέλεσμα πλημμυρών σε γαιοκατασκευές (κατεστραμμένη σιδηροδρομική γραμμή στο Dammam Σαουδικής Αραβίας το 2017 - Dr Bushra Iqbal)

ΑΠΟΨΕΙΣ

Ακραίοι εκφοβισμοί

Δημήτρης Κουτσογιάννης (Ομότιμος Καθηγητής ΕΜΠ, Σχολή Πολιτικών Μηχανικών)

Τα δίκτυα ομβρίων τα σχεδιάζουμε για περίοδο επαναφοράς 5 ως 10 χρόνια. Αυτό σημαίνει πως στην πολύ ευνοϊκή (και όχι πολύ συχνή) περίπτωση που, εκεί που μένουμε, υπάρχει δίκτυο ομβρίων άρτια συντηρούμενο (με τακτικό καθαρισμό φρεατίων κτλ.) θα βλέπουμε τον δρόμο μπροστά στο σπίτι μας να πλημμυρίζει κάθε 5 με 10 χρόνια κατά μέσο όρο.

Τις διευθετήσεις των αστικών ρεμάτων τις σχεδιάζουμε για περίοδο επαναφοράς 50 χρόνια. Αν τώρα σκεφτούμε πρόχειρα ότι στην Ελλάδα υπάρχουν πάνω από 500 οικισμοί με ρέματα ευάλωτα σε πλημμύρες, κι ακόμη κι αν είναι σωστά διευθετημένα, αυτό σημαίνει πως κατά μέσο όρο θα έχουμε κάθε χρόνο τουλάχιστον 10 περιπτώσεις υπερχειλίσεων και πλημμυρικών καταστροφών στη χώρα. Και κάθε διετία θα καταγράφουμε ένα ακραίο γεγονός χιλιετίας κάπου στην Ελλάδα.

Έτσι ορίζουν θεσμικά οι προδιαγραφές της χώρας μας. Θα πει κανείς, γιατί δεν αυξάνουμε τα όρια για να περιορίσουμε τη συχνότητα των καταστροφών; Η απάντηση είναι απλή. Τα αντιπλημμυρικά έργα είναι ακριβά, δεν υπάρχουν χρήματα.

Άρα, οι πλημμύρες και οι καταστροφές που προκαλούν, ήταν, είναι και θα είναι παρούσες. Έχει κάτι αλλάξει σήμερα σε σχέση με παλιότερα;

Ναι, έχει αλλάξει. «Εκεί που φύτρωνε φλισκούνι κι άγρια μέντα», τώρα έχουμε ασφαλτοστρωμένους δρόμους και οικοδομές. Τα όμβρια δεν διηθούνται στο έδαφος, ο όγκος νερού που απορρέει είναι μεγαλύτερος, οι ρυθμοί απορροής εντονότεροι.

Ναι, έχουν αλλάξει κι άλλα. Οι άνθρωποι παλιά ήταν σε αρμονία με τη φύση και ήξεραν να διαχειρίζονται τις δυσκολίες που προκαλούσαν τα φυσικά φαινόμενα. Για παράδειγμα, δεν έχτιζαν πάνω ή δίπλα στις κοίτες των ρεμάτων. Στο ορεινό χωριό που μεγάλωσα, το να ρίχνει ένα μέτρο χιόνι δεν ήταν σπάνιο. Οι γονείς μας καθάριζαν τα μονοπάτια για να πάμε τα παιδιά στο σχολείο. Έτσι, το σχολείο δεν έκλεινε όταν χιόνιζε ή έβρεχε. Γιατί η κοινωνία θεωρούσε φυσικό το να βρέχει και να χιονίζει και ήξερε τι να κάνει.

Έχουμε, δηλαδή, αρνητικές εξελίξεις, αλλά υπάρχουν και τα θετικά που έχουν σχέση με την τεχνολογία. Χάρη σ' αυτή, όχι μόνο έχουμε αποσοβήσει πολλά δεινά, αλλά έχουμε βελτιώσει θεαματικά τον σκληρότερο από τους δείκτες, τα ανθρώπινα θύματα απ' τις φυσικές καταστροφές. Παγκοσμίως, τη δεκαετία του 1920, ανά εκατομμύριο κατοίκους, είχαμε πάνω από 2500 νεκρούς από ξηρασίες· και τη δεκαετία του 1930 σχεδόν 2000 νεκρούς από πλημμύρες. Τη δεκαετία του 2010 οι αντίστοιχοι αριθμοί είναι 3 και 7 νεκροί ανά εκατομμύριο. Μείωση κατά 300 έως 900 φορές—κι ας διατυμπανίζουν τα μέσα ενημέρωσης συνεχώς επιδεινούμενες συνθήκες.

Έχουμε κάποια πρόοδο και στην Ελλάδα; Ναι, βέβαια, σε ότι αφορά την τεχνική πλευρά. Έχουμε κατασκευάσει αρκετά αντιπλημμυρικά έργα. Έχουμε σχέδια διαχείρισης κινδύνων πλημμύρας που έχει συντονίσει η Διεύθυνση Προστασίας και Διαχείρισης Υδάτινου Περιβάλλοντος (πρώην Ειδική Γραμματεία Υδάτων). Έχουμε χάρτες πλημμυρικής διακινδύνευσης. Έχουμε επεξεργαστεί τα ιστορικά αρχεία μετρήσεων. Για παράδειγμα, έχουμε ξεχωρίσει 238 βροχομετρικούς σταθμούς με δεδομένα μέγιστων βροχοπτώσεων από 60 χρόνια και πάνω. Εννοείται πως υπάρχουν πολλοί περισσότεροι, αλλά μόνο αυτοί με μεγάλο μήκος παρατηρήσεων προσφέρονται για κλιματικές αναλύσεις[1].

Η επιστημονική μέθοδος επιβάλλει συγκρίσεις παλιότερων με νεότερες συνθήκες να γίνονται μεταξύ όμοιων δεικτών και όχι κατά βούληση και κατά πώς βολεύει. Ο πιο χαρακτηριστικός δείκτης, τον οποίον υποστηρίζουν οι προαναφερόμενες 238 χρονοσειρές μετρήσεων, είναι το μέγιστο ημερήσιο ύψος βροχής, η μέτρηση του οποίου, κατά τη συνήθη σύμβαση, λαμβάνεται στις 8:00 μιας συγκεκριμένης ημέρας και περιλαμβάνει το σύνολο της βροχόπτωσης από τις 8:00 της προηγούμενης.

Με βάση τις εν λόγω 238 χρονοσειρές μετρήσεων, το ρεκόρ 24ωρης βροχόπτωσης στη χώρα σημειώθηκε στη Μακρινίτσα το 1957 και ήταν 580 χιλιοστά. Από τις 238 χρονοσειρές, αυτή με το μεγαλύτερο μήκος (157 χρόνια) είναι του Λόφου Νυμφών στην Αθήνα, όπου το ρεκόρ σημειώθηκε το υδρολογικό έτος 1899-1900 και ήταν 150 χιλιοστά. Τα επόμενα 123 χρόνια, δεν ξεπεράστηκε—ούτε βέβαια στο πρόσφατο επεισόδιο που έβρεξε 85 χιλιοστά. Το πιθανότερο είναι πως ούτε στη Μακρινίτσα ξεπεράστηκε το ρεκόρ των 580 χιλιοστών. Δυστυχώς δεν έχουμε την πλήρη μέτρηση: λόγω υπερχείλισης του βροχομέτρου γνωρίζουμε μόνο πως ήταν πάνω από 100 χιλιοστά. Τα δορυφορικά δεδομένα IMERG της NASA δίνουν το μέγιστο ημερήσιο ύψος βροχής στη Μακρινίτσα να μην ξεπερνά τα 250 χιλιοστά (και στην ευρύτερη περιοχή να τα ξεπερνά ελάχιστα). Η τιμή αυτή βρέθηκε με την προαναφερθείσα συνήθη σύμβαση για ημερήσια ύψη βροχής και μετά από αναγωγή του επιφανειακού δορυφορικού ύψους βροχής σε σημειακό. Ας σημειωθεί όμως ότι τα δορυφορικά δεδομένα δεν είναι εξίσου ακριβή με τα επίγεια και δεν μπορεί να αποκλειστεί κάποια υπεκτίμηση των υψών βροχής.

Σε κάθε περίπτωση, είχαμε ένα εξαιρετικά ακραίο επεισόδιο βροχής, αλλά μέσα στο πλαίσιο των στοχαστικών προγνώσεων για ακραίες βροχοπτώσεις. Συγκεκριμένα, σύμφωνα με την φετινή αναθεώρηση των σχεδίων διαχείρισης κινδύνων πλημμύρας, η ημερήσια βροχόπτωση χιλιετίας που αναμένουμε στην περιοχή του ανατολικού Πηλίου (από τις δυσμενέστερες στην Ελλάδα) είναι 810 χιλιοστά—κι αυτό σίγουρα δεν το πλησιάσαμε.

Αλλά, όπως είπαμε, εξαιρετικά ακραία γεγονότα, όπως το πρόσφατο, συνέβαιναν και θα συμβαίνουν. Κάποιοι σπεύδουν να τα αποδώσουν στην κλιματική αλλαγή, εκφοβίζοντας τον πληθυσμό με την απειλή πως θα γίνονται όλο και πιο έντονα. Ίσως αγνοούν ότι κλιματική αλλαγή, που όπως λένε «είναι εδώ», πράγματι «ήταν εδώ» σε όλα τα 4.5 δισεκατομμύρια χρόνια ιστορίας της Γης. Ή ίσως ψάχνουν για αποδιοπομπαίους τράγους—και, ως γνωστόν, οι προσφορότεροι είναι η κλιματική κρίση και ο Πούτιν.

Όσοι μιλούν για κλιματική κρίση δεν υπηρετούν την επιστημονική αλήθεια και δεοντολογία—αφού η κλιματική κρίση δεν είναι φυσικό γεγονός (και ως τέτοιο, αντικείμενο της επιστήμης), αλλά πολιτικό. Ούτε υπηρετούν το κοινωνικό και το εθνικό συμφέρον. Ούτε προτείνουν κάτι που θα βοηθούσε τους πάσχοντες, ή την προστασία της χώρας απέναντι στα ακραία φαινόμενα. Αντικειμενικά, εν αγνοία τους ή ηθελημένα, τις υπηρεσίες τους τις προσφέρουν στα συμφέροντα που προωθούν τη διεθνή πολιτική ατζέντα της κλιματικής κρίσης.

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[1] Αποτελέσματα λεπτομερών αναλύσεων κλιματικών τάσεων έχουν πρόσφατα δημοσιευτεί στην εργασία: «In search of climate crisis in Greece using hydrological data: 404 Not Found» (D. Koutsoyiannis, T. Iliopoulou, A. Koukouvinos, N. Malamos, N. Mamassis, P. Dimitriadis, N Tepetidis, and D. Markantonis, Water, 15 (9), 1711, http://dx.doi.org/10.3390/w15091711, 2023.

Το άρθρο δημοσιεύθηκε, μετά από πρόσκληση, στο *Το Βήμα της Κυριακής*, doi:10.13140/RG.2.2.12161.63844, Αθήνα, 10 September 2023.

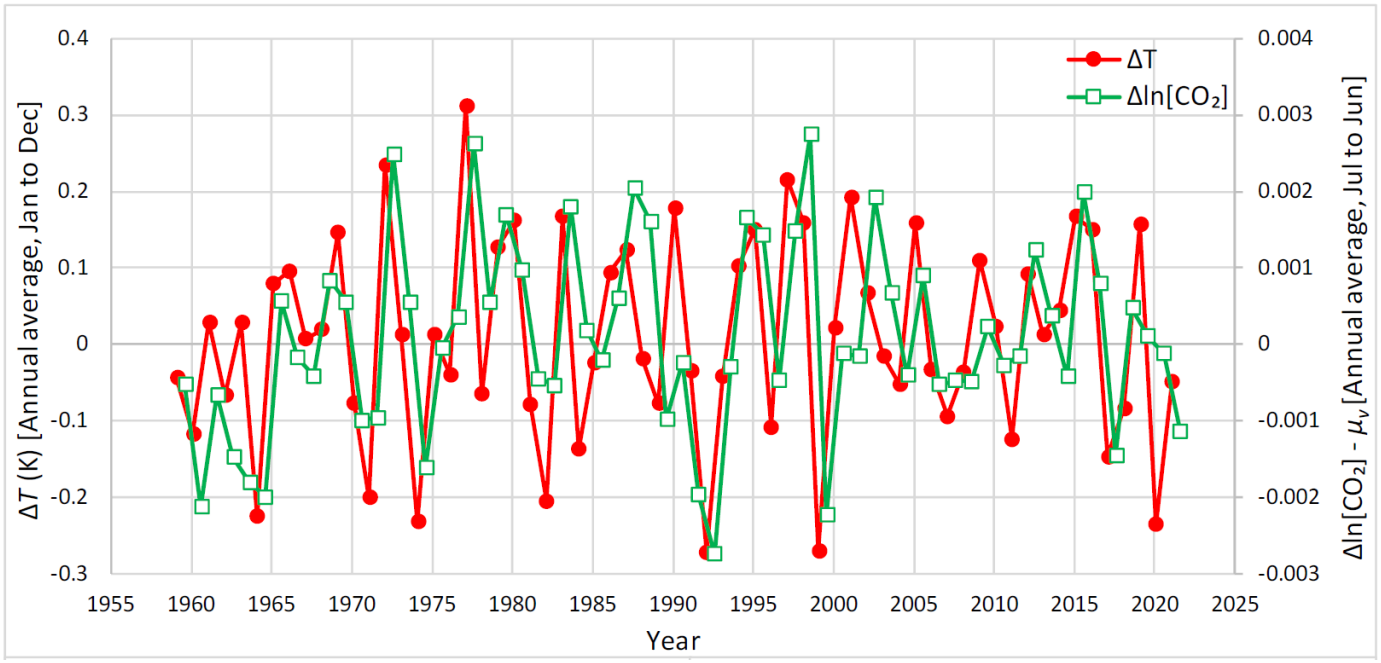
Η κλιματική κρίση είναι εδώ -- ως πολιτικό και όχι ως φυσικό γεγονός

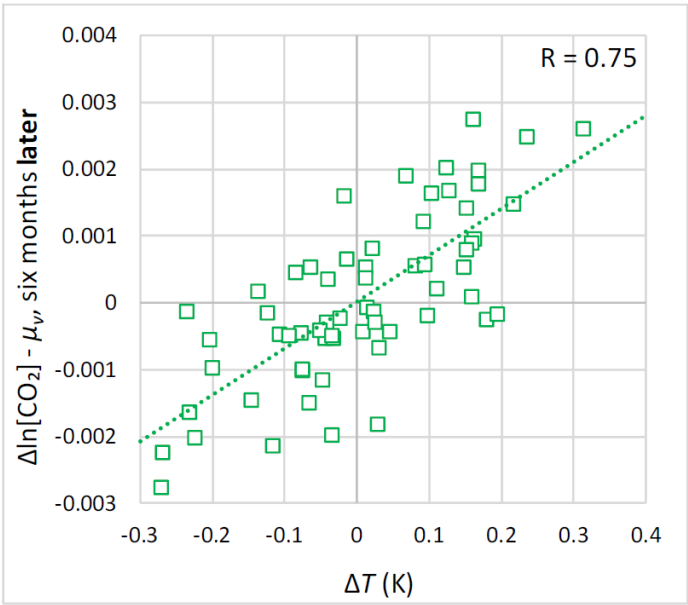
Quiz: Assuming a potentially causal relationship between the atmospheric temperature (T) and atmospheric concentration of carbon dioxide ([CO_2]), which is the cause and which the effect?

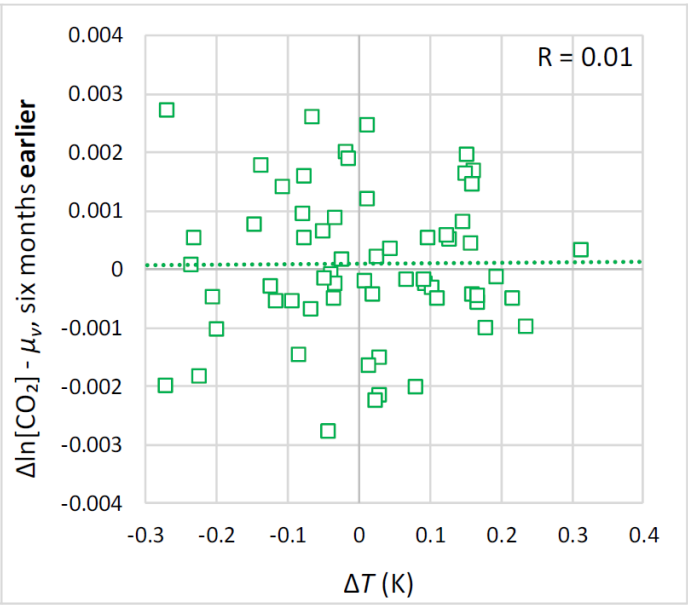
Hint: Use the graphs below without mathematical analyses.

Explanations:

1. The values plotted are annual averages of differenced time series for differencing time step of 1 year; in particular [CO_2] is logarithmically transformed.
2. Each point represents the time average for a duration of one-year ending at the time of its abscissa. The two time series are lagged with a time difference of six months. That is, each green square is half-way (in time) between two consecutive red dots (the annual average for ΔT is taken from January to December and that for $\Delta\ln[CO_2]$ from July to June).
3. *T is* the global average of the atmospheric temperature from the NCAR/NCEP reanalysis; [CO_2] is the atmospheric concentration of carbon dioxide of the Mauna Loa observatory (Hawaii, USA).
4. The quantity μv subtracted from $\Delta\ln[CO_2]$ is determined by equation (10) in Koutsoyiannis et al. (2023, "On hens, eggs, temperatures and CO_2: Causal links in Earth's atmosphere"), i.e., μ_v=0.0034 (T_4/K−285.84), where T_4 is the average temperature of the previous 4 years and K is the unit of kelvin.







Δημήτρης Κουτσογιάννης

ΥΓ. Το γιατί η κλιματική κρίση είναι πολιτικό γεγονός, καθώς και την αυθεντική του προέλευση ως τέτοιου, τα εξηγώ σε άλλη δημοσίευση, Rethinking climate, climate change, and their relationship with water καθώς και στην παρουσίασή μου The political origin of the climate change agenda (διαφάνειες στα αγγλικά, βίντεο στα ελληνικά).

ΕΝΑΡΚΤΗΡΙΟΣ ΧΑΙΡΕΤΙΣΜΟΣ

Σας καλωσορίζω στο 9ο Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής.

Στόχος του συνεδρίου μας πάντα είναι να καταγράφει τις προόδους της γεωτεχνικής μηχανικής στην Ελλάδα και στην Κύπρο, όπως αντικατοπτρίζονται στα σημαντικά γεωτεχνικά έρ-γα που έχουν μελετηθεί και κατασκευαστεί, καθώς και στα αποτελέσματα της ερευνητικής δραστηριότητας των Πολυτεχνείων και Πολυτεχνικών Σχολών της Ελλάδας και της Κύπρου. Επιδίωξη είναι οι εργασίες του συνεδρίου να αναδεικνύουν πρωτότυπα στοιχεία συμβολής της γεωτεχνικής μηχανικής στα τεχνικά έργα αλλά και να προβάλλουν θεωρητικές και πειραματικές έρευνες σε εδαφικά, βραχώδη και ημιβραχώδη υλικά που έχουν βρει ή μπορούν να βρουν εφαρμογή στην πράξη.

Πρόσθετα όμως, το χρονικό διάστημα από το προηγούμενο Πανελλήνιο Συνέδριο είδαμε πολύ μεγάλη αύξηση των μελετώμενων και κατασκευαζόμενων τεχνικών έργων στη χώρα με σημαντική συνεισφορά της γεωτεχνικής μηχανικής και των γεωτεχνικών μηχανικών στον σχεδιασμό τους και την επιτυχή ολοκλήρωσή τους. Η αύξηση αυτή μεταφράστηκε σε σημαντική ζήτηση για γεωτεχνικούς μηχανικούς δίνοντας μια νέα προοπτική στο επάγγελμά μας, την οποία αναμένουμε να δού-με να γίνεται αυξημένο ενδιαφέρον των φοιτητών για εξειδίκευση στη γεωτεχνική μηχανική στα Πολυτεχνεία και στις Πολυτεχνικές Σχολές και αντίστοιχη αύξηση της ήδη μεγάλης ερευνητικής δραστηριότητας στο αντικείμενο. Αντίστοιχη ήταν και η ανταπόκριση στην πρόσκληση του Συνεδρίου: περισσότερα από 120 τελικώς εγκριθέντα άρθρα, 15 ειδικές ομιλίες, μεταξύ αυτών και η 14η Αθηναϊκή Διάλεξη Γεωτεχνικής Μηχανικής, ενταγμένη για πρώτη φορά στο Πανελλήνιο Συνέδριο. Μεγάλη ήταν και η προσπάθεια για την αξιολόγηση των άρθρων: περίπου 45 γεωτεχνικοί ανέλαβαν τη διπλή ανεξάρτητη και ανώνυμη κρίση κάθε υποβληθέντος άρθρου, συμβάλλοντας καθοριστικά στην ποιότητα του Συνεδρίου.

Σε αυτό το πλαίσιο, το 9ο Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής φιλοδοξεί να αποτελέσει το σημείο συνάντησης των γεωτεχνικών μηχανικών της χώρας και τη μεγαλύτερη εκδήλωση προβολής της επαγγελματικής και ερευνητικής δραστηριότητας στο αντικείμενο της γεωτεχνικής μηχανικής, μέσω της καταγραφής της εμπειρίας από αυτήν την αυξημένη δραστηριότητα των τελευταίων ετών και της διατύπωσης των αναγκών του αντικειμένου μας για το μέλλον. Η ενεργός συμμετοχή των συνέδρων και η παρακολούθηση των διαλέξεων θα κρίνει και το τελικό αποτέλεσμα που τίθεται στην κρίση σας.

Ο Πρόεδρος του Συνεδρίου
Δρ Μ. Μπαρδάνης
Πρόεδρος Ε.Ε.Ε.Ε.Γ.Μ.

ΟΡΓΑΝΩΤΙΚΗ ΚΑΙ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΠΙΤΡΟΠΗ ΚΡΙΤΕΣ ΕΠΙΣΤΗΜΟΝΙΚΩΝ ΑΡΘΡΩΝ

Πρόεδρος του Συνεδρίου

Μ. Μπαρδάνης, *Πρόεδρος Ε.Ε.Ε.Ε.Γ.Μ.*

Οργανωτική και Επιστημονική Επιτροπή

Γ. Μπελόκας, *Γενικός Γραμματέας Ε.Ε.Ε.Ε.Γ.Μ.*
Γ. Ντούλης, *Ταμίας Ε.Ε.Ε.Ε.Γ.Μ.*
Α. Αναγνωστόπουλος, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Π. Βέττας, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Γ**. Γκαζέτας**, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Ι. Ζευγώλης, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Β. Ξενάκη, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Μ. Πανταζίδου, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Μ. Παχάκης, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Κ. Πλυτάς, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
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Χρ. Τσατσανίφος, *Εκτελεστική Επιτροπή Ε.Ε.Ε.Ε.Γ.Μ.*
Ν. Ρούσσος, *Πρόεδρος Ελληνικής Επιτροπής Σηράγγων & Υπόγειων Έργων*
Ζ. Ρ. Παπαχατζάκη, *Πρόεδρος Ελληνικής Επιτροπής Μεγάλων Φραγμάτων*
Ι. Μάρκου, *Πρόεδρος Ελληνικού Συνδέσμου Γεωσυνθετικών Υλικών*
Κ. Γεωργιάδης, *Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης*
Δ. Πιτιλάκης, *Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης*
Στ. Κοντοέ, *Πανεπιστήμιο Πατρών*
Ν. Κλήμης, *Δημοκρίτειο Πανεπιστήμιο Θράκης*
Π. Ντακούλας, *Πανεπιστήμιο Θεσσαλίας*
Δ. Λουκίδης, *Πανεπιστήμιο Κύπρου*

Πρόσθετοι κριτές επιστημονικών άρθρων

Σ. Αποστολάκη, Π. Αστερίου, Β. Βαντόλας, Α. Βρατσικίδης, Κ. Γεωργιάδης, Α. Γραμματικοπούλου, Α. Δεληβέρης, Δ. Εγγλέζος, Α. Θεοχάρης, Α. Καπουνιάρης, Ζ. Καράτζα, Α. Καρατζέτζου, Σ. Καραφαγκά, Ε.Ι. Κουτσουπάκη, Γ. Κρούπη, Ο.Τ. Κτενίδου, Α.Χ. Λιβανίδου, Κ. Μάκρα, Κ. Μπαντραλέξης, Ε. Πεταλά, Ι. Πιλαλίδης, Ε. Ροβίθης, Δ. Σωτηριάδης, Π. Τσουνάμη, Ε. Φίλογλου, Ε. Ψαρουδάκης

ΣΥΝΕΔΡΙΕΣ

Συνεδρία Ι Έρευνα πεδίου & εργαστήριου
Συνεδρία ΙΙ Εδαφοδυναμική Ι
Συνεδρία ΙΙΙ Βραχομηχανική
Συνεδρία ΙV Βελτιώσεις Εδαφών
Συνεδρία V Εδαφοδυναμική ΙΙ
Συνεδρία VI Αλληλεπίδραση εδάφους-κατασκευής
Συνεδρία VII Καταστατικά προσομοιώματα
Συνεδρία VIII Άοπλα και Οπλισμένα Επιχώματα
Συνεδρία IX Θεμελιώσεις Ι
Συνεδρία X Περιβαλλοντική Γεωτεχνική / Θέματα Διδασκαλίας
Συνεδρία XI Ευστάθεια πρανών/κατολισθήσεις
Συνεδρία XII Σήραγγες & Υπόγεια Έργα - Βαθειές Αντιστηρίξεις
Συνεδρία XIII Ευρωκώδικες - Εφαρμογές Γεωσυνθετικών Υλικών
Συνεδρία XIV Θεμελιώσεις ΙΙ
Συνεδρία XV Εδαφοδυναμική ΙΙΙ - Φράγματα
Συνεδρία XVI Αβεβαιότητα, Αξιοπιστία, και Διακινδύνευση στη Γεωτεχνική
Συνεδρία XVII Γεωτεχνική μηχανική και μνημεία

ΠΡΟΣΚΕΚΛΗΜΕΝΟΙ ΟΜΙΛΗΤΕΣ

Τετάρτη 4 Οκτωβρίου 2023

Paul W. Mayne *Geoengineering Consultant, Emeritus Professor- Geosystems Engineering Group, School of Civil & Environmental Engineering, Georgia Institute of Technology, Atlanta, GA USA*

Τίτλος Ομιλίας: **14η Αθηναϊκή Διάλεξη - Paul Mayne**

Geotechnical Site Characterization Using Shear Wave Velocity

Πέμπτη 5 Οκτωβρίου 2023

Jorge G. Zornberg *Ph.D., P.E., F. ASCE, Brunswick-Abernathy Regents Professor, The University of Texas at Austin, Past-President, International Geosynthetics Society*

Τίτλος Ομιλίας: **Geosynthetic Applications in Railways and Roadways**

Loretta Batalli *Professor of Soil Mechanics and Foundation Engineering, Technical University of Civil Engineering Bucharest, Romania*

Τίτλος Ομιλίας: **Aspects related to slope stability of waste landfills – case studies and numerical modelling**

ΕΙΔΙΚΕΣ ΟΜΙΛΙΕΣ

Τετάρτη 4 Οκτωβρίου 2023

Ρίτσος Α. *Μέτοχος και Μέλος του Δ.Σ. στην εταιρία ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Τ.Ε. Εταίρος στην εταιρία ΓΕΩΤΕΧΝΙΚΕΣ ΕΡΕΥΝΕΣ Τ.Ε.Ε. Αντιπρόεδρος στον Ελληνικό Σύνδεσμο Γεωσυνθετικών Υλικών*

Τίτλος Ομιλίας: **Πρεσσιόμετρο Menard (MPM) – Εφαρμογή στην Ελλάδα**

Ρήγα Ε. *Δρ Πολιτικός Μηχανικός ΑΠΘ, μέλος Ε.Δι.Π. του Εργαστηρίου Εδαφομηχανικής, Θεμελιώσεων & Γεωτεχνικής Σεισμικής Μηχανικής του Τμήματος Πολιτικών Μηχανικών του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης*

Τίτλος Ομιλίας: **Σεισμικές δράσεις σχεδιασμού στον υπό αναθεώρηση Ευρωκώδικα 8. Πρόταση για το Ελληνικό Εθνικό Προσάρτημα**

Νομικός Π. *Καθηγητής Γεωτεχνολογίας - Βραχομηχανικής, Διευθυντής Εργαστηρίου Τεχνολογίας Διάνοιξης Σηράγγων, Σχολή Μεταλλειολόγων – Μεταλλουργών Μηχανικών, Εθνικού Μετσόβιου Πολυτεχνείου*

Τίτλος Ομιλίας: **Προς μία ρεαλιστική μοντελοποίηση της μηχανικής συμπεριφοράς της βραχομάζας**

Διδασκάλου Γ. *Πολιτικός Μηχανικός, MSc, Διευθυντής «ΓΕΩΡΓΙΟΣ ΔΙΔΑΣΚΑΛΟΥ & ΣΙΑ Ε.Ε. - ΓΕΩΤΕΡ ΔΙΔΑΣΚΑΛΟΥ»*

Τίτλος Ομιλίας: **Παρουσίαση του επίπεδου Ντιλατομέτρου τύπου Marchetti, της χρήσης του στο πεδίο, της αξιολόγησης των μετρήσεων του και του συνδυασμού του με άλλα όργανα και δοκιμές στο πλαίσιο της γεωτεχνικής αξιολόγησης**

Πέμπτη 5 Οκτωβρίου 2023

Πιτιλάκης Δ. *Αναπληρωτής Καθηγητής και Διευθυντής του Προγράμματος Μεταπτυχιακών Σπουδών "Αειφόρος Σχεδιασμός Τεχνικών Έργων έναντι σεισμού και άλλων φυσικών κινδύνων" του Τμήματος Πολιτικών Μηχανικών Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης*

Τίτλος Ομιλίας: **Γεωτεχνική σεισμική μόνωση**

Κουρκουλής Ρ. *Δρ Πολιτικός Μηχανικός, Ιδρυτικό Μέλος & Εταίρος, Grid Engineers ΙΚΕ*

Τίτλος Ομιλίας: **Προκλήσεις κατά τον σχεδιασμό υπεράκτιων ανεμογεννητριών: Ο ρόλος της θεμελίωσης**

Παπαδημητρίου Α. *Αναπληρωτής Καθηγητής Γεωτεχνικής Μηχανικής, Διευθυντής Εργαστηρίου Θεμελιώσεων, Σχολή Πολιτικών Μηχανικών, Εθνικού Μετσοβίου Πολυτεχνείου*

Τίτλος Ομιλίας: **Αλληλεπίδραση γειτονικών κατασκευών με ή χωρίς βελτίωση εδάφους έναντι σεισμικής ρευστοποίησης**

Κωμοδρόμος Α. *Καθηγητής, Τμ. Πολ. Μηχανικών Πανεπιστημίου Θεσσαλίας*

Τίτλος Ομιλίας: **Συμβολή στην ανάλυση και τον σχεδιασμό θεμελιώσεων με πασσάλους με χρήση προηγμένων αριθμητικών μεθόδων**

Μπαρδάνης Μ. *Δρ Πολιτικός Μηχανικός, Πρόεδρος ΕΕΕΕΓΜ, Διευθυντής Εργαστηρίου ΕΔΑΦΟΣ Σύμβουλοι Μηχανικοί Α.Ε.*

Τίτλος Ομιλίας: **Τα έργα αποκατάστασης της ευστάθειας στο πρανές της Διώρυγας της Κορίνθου από την πλευρά της Πελοποννήσου μετά τις καταπτώσεις του 2021**

Παρασκευή 6 Οκτωβρίου 2023

Μπελόκας Γ. *Επίκουρος Καθηγητής, Διευθυντής Εργαστηρίου Εδαφομηχανικής, Τμήμα Πολιτικών Μηχανικών, Πανεπιστήμιο Δυτικής Αττικής*

Τίτλος Ομιλίας: **Ευρωκώδικας 7 – 2η Γενιά: Αλλαγές και Προκλήσεις στην Ανάλυση και στο Σχεδιασμό Γεωτεχνικών Έργων**

Λουκίδης Δ. *Αναπληρωτής Καθηγητής Τμήμα Πολιτικών Μηχανικών & Μηχανικών Περιβάλλοντος, Πανεπιστήμιο Κύπρου*

Τίτλος Ομιλίας: **Ογκομετρικές παραμορφώσεις μη κορεσμένων εδαφών λόγω μεταβολής της περιεχόμενης υγρασίας**

Γαρίνη Ε. *Επίκουρη Καθηγήτρια, Τμήμα Μηχανικών Ορυκτών Πόρων, Πολυτεχνείο Κρήτης*

Τίτλος Ομιλίας: **Σεισμική ακολουθία 6ης Φεβρουαρίου 2023 στην Τουρκία: Διάρρηξη, καταγραφές, εγγύς-τουρήγματος φαινόμενα, γεωτεχνικές βλάβες**

ΕΙΔΙΚΗ ΣΥΝΕΔΡΙΑ ΠΡΟΣ ΤΙΜΗΝ ΤΟΥ ΠΑΥΛΟΥ ΜΑΡΙΝΟΥ

Τετάρτη 4 Οκτωβρίου 2023

Τσιαμπάος Γ. *Ομότιμος Καθηγητής ΕΜΠ*

Τίτλος Ομιλίας: **"Παύλος Μαρίνος: Ένας ξεχωριστός Πανεπιστημιακός Δάσκαλος και Ερευνητής"**

Στούμπος Γ. *Τεχνικός Γεωλόγος, Msc, Ελληνικό Μετρό Α.Ε.*

Τίτλος Ομιλίας: **Η εικοσαετής προσφορά του Παύλου Μαρίνου στα έργα Μετρό και η παρακαταθήκη του - Η τεχνική γεωλογία στον γεωτεχνικό σχεδιασμό του Μετρό**

Καζίλης Ν. *Τεχνικός Γεωλόγος, Msc, / DIC*

Τίτλος Ομιλίας: **Έργα και Ημέρες του αείμνηστου Καθηγητή Παύλου Μαρίνου στον χώρο των μεγάλων κατασκευών (Φραγμάτων – Ταμιευτήρων, Σήραγγων, Αντιμετώπιση κατολισθήσεων κτλ)**

Μαρίνος Β. *Επίκουρος Καθηγητής ΕΜΠ, Προέδρος IAEG*

Τίτλος Ομιλίας: **Παύλος Γ. Μαρίνος: Ο Πατέρας, ο Μέντορας, ο Επιστήμονας**

ΣΥΝΟΠΤΙΚΟ ΠΡΟΓΡΑΜΜΑ

1η Ημέρα Συνεδρίου • Τετάρτη 4 Οκτωβρίου 2023		
	ΚΕΝΤΡΙΚΟ ΑΜΦΙΘΕΑΤΡΟ	**ΑΙΘΟΥΣΑ ΔΙΑΛΕΞΕΩΝ Α**
10:00-10:30	**Έναρξη Συνεδρίου - Χαιρετισμοί**	
10:30-11:30	**14η Αθηναϊκή Διάλεξη - Paul Mayne**	
11:30-11:45	Διάλειμμα καφέ	
11:45-14:00	**ΣΥΝΕΔΡΙΑ Ι:** ΕΡΕΥΝΑ ΠΕΔΙΟΥ & ΕΡΓΑΣΤΗΡΙΟΥ	**ΣΥΝΕΔΡΙΑ ΙΙ:** ΕΔΑΦΟΔΥΝΑΜΙΚΗ Ι
14:00-15:00	Μεσημβρινή διακοπή	
15:00-16:00	**Συνεδρία προς τιμήν του Παύλου Μαρίνου**	
16:00-16:15	Διάλειμμα καφέ	
16:15-18:30	**ΣΥΝΕΔΡΙΑ ΙΙΙ**: ΒΡΑΧΟΜΗΧΑΝΙΚΗ	**ΣΥΝΕΔΡΙΑ IV:** ΒΕΛΤΙΩΣΕΙΣ ΕΔΑΦΩΝ
19:00-21:00	**Δεξίωση Υποδοχής**	

2η Ημέρα Συνεδρίου • Πέμπτη 5 Οκτωβρίου 2023		
	ΚΕΝΤΡΙΚΟ ΑΜΦΙΘΕΑΤΡΟ	**ΑΙΘΟΥΣΑ ΔΙΑΛΕΞΕΩΝ Α**
09:30-11:30	**ΣΥΝΕΔΡΙΑ V:** ΕΔΑΦΟΔΥΝΑΜΙΚΗ ΙΙ	**ΣΥΝΕΔΡΙΑ VI:** ΑΛΛΗΛΕΠΙΔΡΑΣΗ ΕΔΑΦΟΥΣ - ΚΑΤΑΣΚΕΥΗΣ
11:30-11:45	Διάλειμμα καφέ	
11:45-12:45	**Ομιλία Jorge Zornberg**	
12:45-14:00	**ΣΥΝΕΔΡΙΑ VII:** ΚΑΤΑΣΤΑΤΙΚΑ ΠΡΟΣΟΜΟΙΩΜΑΤΑ	**ΣΥΝΕΔΡΙΑ VIII:** ΑΟΠΛΑ ΚΑΙ ΟΠΛΙΣΜΕΝΑ ΕΠΙΧΩΜΑΤΑ
14:00-15:00	Μεσημβρινή διακοπή	
15:00-16:00	**ΣΥΝΕΔΡΙΑ IX:** ΘΕΜΕΛΙΩΣΕΙΣ Ι	**ΣΥΝΕΔΡΙΑ X:** ΠΕΡΙΒΑΛΛΟΝΤΙΚΗ ΓΕΩΤΕΧΝΙΚΗ / ΘΕΜΑΤΑ ΔΙΔΑΣΚΑΛΙΑΣ
16:00-16:15	Διάλειμμα καφέ	
16:15-18:30	**ΣΥΝΕΔΡΙΑ XI:** ΕΥΣΤΑΘΕΙΑ ΠΡΑΝΩΝ/ ΚΑΤΟΛΙΣΘΗΣΕΙΣ	**ΣΥΝΕΔΡΙΑ XII:** ΣΗΡΑΓΓΕΣ & ΥΠΟΓΕΙΑ ΕΡΓΑ – ΒΑΘΕΙΕΣ ΑΝΤΙΣΤΗΡΙΞΕΙΣ
18:30	**ΓΕΝΙΚΗ ΣΥΝΕΛΕΥΣΗ & ΕΚΛΟΓΕΣ ΕΕΕΕΓΜ**	

3η Ημέρα Συνεδρίου • Παρασκευή 6 Οκτωβρίου 2023		
	ΚΕΝΤΡΙΚΟ ΑΜΦΙΘΕΑΤΡΟ	**ΑΙΘΟΥΣΑΝ ΔΙΑΛΕΞΕΩΝ Α**
09:30-11:00	**ΣΥΝΕΔΡΙΑ XIII:** ΕΥΡΩΚΩΔΙΚΕΣ – ΕΦΑΡΜΟΓΕΣ ΓΕΩΣΥΝΘΕΤΙΚΩΝ ΥΛΙΚΩΝ	**ΣΥΝΕΔΡΙΑ XIV:** ΘΕΜΕΛΙΩΣΕΙΣ ΙΙ
11:00-11:15	Διάλειμμα καφέ	
11:15-12:45	**ΣΥΝΕΔΡΙΑ XV:** ΕΔΑΦΟΔΥΝΑΜΙΚΗ ΙΙΙ-ΦΡΑΓΜΑΤΑ	**ΣΥΝΕΔΡΙΑ XVI:** ΑΒΕΒΑΙΟΤΗΤΑ, ΑΞΙΟΠΙΣΤΙΑ, ΚΑΙ ΔΙΑΚΙΝΔΥΝΕΥΣΗ ΣΤΗ ΓΕΩΤΕΧΝΙΚΗ
12:45-13:00	Διάλειμμα καφέ	
13:00-14:15	**ΣΥΝΕΔΡΙΑ XVII:** ΓΕΩΤΕΧΝΙΚΗ ΜΗΧΑΝΙΚΗ ΚΑΙ ΜΝΗΜΕΙΑ	
14:15-14:45	**Λήξη συνεδρίου**	

ΑΡΘΡΑ

Learning from Hong Kong's approach to landslide risk management

Without proactive management of landslide risk Hong Kong's recent extreme rainstorm would have caused much more devastation, writes the leader of Arup's engineering geology team in Hong Kong, Stuart Millis.

The-aftermath-of-the-landslide-at-Yiu-Hing-Road

The rainstorm on 7/8 September 2023 had peak rainfall rates of almost 160mm/hour and resulted in over 900mm of rainfall in just 12 hours in some hard-hit areas, such as eastern Hong Kong Island. For reference, the typical monthly rainfall rate for September is about 320mm, meaning this storm dropped almost three times the monthly average in less than 24 hours.

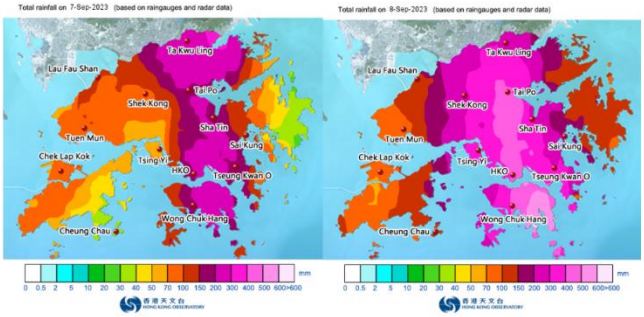
All this came just a week after Super Typhoon Saola had hit Hong Kong. Although the rainfall during the typhoon was not especially noteworthy (around 150mm), it still exceeded the entire monthly rainfall in August 2023. The typhoon also caused significant disturbance of vegetation, which will have started to clog up drainage channels.

The sheer intensity of the storm on the 7/8 September 2023, coupled with a groundmass that had been pre-saturated a short while before, resulted in conditions that were primed for land sliding.

Although notable throughout most of the territory, the most significant concentrations of rainfall were over the eastern parts of Hong Kong Island, where the 24 hour rainfall rate exceeded 900mm, as well as Kowloon and the Central New Territories. So essentially, the storm hit many of the most densely developed urban areas of the Hong Kong Special Administrative Region (HKSAR).

Yiu Hing Road landslide

The landslide at Yiu Hing Road was by far the largest and most prominent of the failures that occurred during the rainstorm. Whether it was the most significant is open to debate, especially if you happen to be a resident in south eastern Hong Kong Island (Shek O), which was cut off for over 24 hours due to landslides damaging the sole access road, or living in one of the houses at the nearby Red Hill Peninsula in Tai Tam, where large coastal slope landslides undermined several properties.



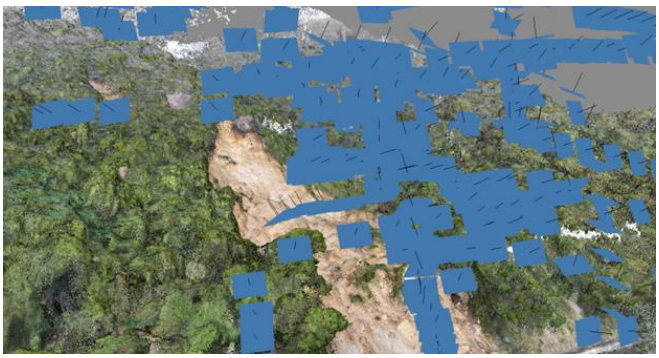
Rainfall in Hong Kong on 7 September (left) and 8 September (right) from the Hong Kong Observatory

Although much larger and more prominent, the Yiu Hing Road landslide impacted a road with relatively low traffic density and strategic significance. This is rather fortunate given the time that will no doubt be required to make the area safe once again.

It occurred within an area of densely vegetated natural hillside directly above a large pre-existing soil and rock cut slope that is about 55m high. The geology in this part of Hong Kong comprises fine-to-medium grained granite, with the bedrock strata overlain by a mantle of saprolite (in-situ weathered strata) that generally varies between about 3m to 10m in thickness based on the available nearby ground investigation data. Exposed rock is apparent in the drainage lines either side of the interfluve on which the landslide occurred.

At the time of writing, no one has been able to safely access the landslide scar for a detailed look due to the continued heavy rain. As such only preliminary interpretations from drone photographs and their associated photogrammetric models can be made.

However, initial measurements from photogrammetric models of the landslide we've built over the last few days show the main body of the scar to be about 25m to 30m wide, about 40m to 50m plan length and with depths between about 3m to 5m, all of which suggests that over a 1,000m^3 of material was mobilised.



A photogrammetric model of the Yiu Hing Road landslide supplied by Millis

Reviews of the available photographs suggest that the landslide comprised a translational debris slide that occurred along a highly persistent and adversely oriented discontinuity at, or slightly beneath, rockhead level. The orientation and high persistence of the discontinuity at the rupture surface, together with the notable presence of other discontinuities with similar conditions elsewhere throughout the hillside, is suggestive of the feature being a sheeting joint.

Given the high proportion of rock within the landslide debris and the fact that a significant amount of this comprised angular rock fragments, as opposed to the rounded boulders typically associated with granitic corestones, initial interpretations are that the rupture surface formed along a shallow and persistent sheeting joint.

Another photogrammetric model of Yiu Hing Road supplied by Millis

The groundmass above this was most likely mobilised as a result of the build-up of high transient porewater pressures along the sheeting joint. This build-up of porewater pressure would have reduced the effective stress along the joint surface to the point where shearing was initiated and the overlying sheeting slabs and weathered material were mobilised downslope.

Although it's hard to say with any certainty until the scar has been inspected in detail, notable areas with a lighter hue are apparent on the rupture surface suggesting the possible presence of kaolin on the joint surface, which would have further reduced its shear strength. The presence of kaolin-rich zones and kaolin infill in low angle discontinuities (e.g. sheeting joints) in the zones close to the weathering front is not uncommon and has been observed in several highly notable past landslides such as those at Shum Wan Road (1995) and Fei Tsui Road (1995).

Risk factors

The main factor contributing to landslide risk in Hong Kong is the proximity of infrastructure and developments to areas of steep terrain. With a natural topography that essentially comprises a bunch of hills poking out of the sea, readily developable land is scarce.

With most of the easily developable areas on flat land used up long ago, there has generally been two options available for new development, either reclaim land from the sea, or undertake site formation to develop land within hilly terrain.

Although reclamation has been used extensively in the past and is starting to be increasingly used again, the majority of the major developments in the last 20 to 30 years have taken place within the urban fringe and along the foot slopes of major hillsides. This encroachment into hilly areas means the risks from landslides are ever present.

Landslides are therefore not uncommon in Hong Kong, with the territory having experienced an average of about 300 failures a year over the last 35 years.

However, what has changed over the last few decades is the nature and impact of the landslides that we are having. While numerous large-scale failures of man-made slopes and retaining walls occurred in the 1970s and 1980s, the measures implemented by the government in Hong Kong over the last 40 years means that the landslides currently occurring are either much smaller scale failures on man-made slopes and retaining walls or landslides coming from natural hillside areas.

History of landslides

Hong Kong has what is widely considered to be the most proactive, progressive and well managed system for landslide risk management globally. The government is currently spending around HK$1bn (£103M) annually specifically on landslide risk management that facilitates the study and upgrading of man-made slopes as well as the mitigation of natural terrain hazards, a commitment to slope safety that I think nowhere else in the world even comes close to.

Landslide risk management in Hong Kong really kicked off in the late-1970s following the catastrophic and fatal landslides at Sau Mau Ping, where major fill slope failures in 1972 and 1976 resulted in close to 100 fatalities, and Po Shan Road in 1972, where instability within a site formation project led to undermining of the adjacent hillside and a major debris flow that resulted in 67 fatalities. These incidents highlighted the risks associated with the various man-made slopes and walls throughout the HKSAR.

In 1977, the Hong Kong Government set up the Geotechnical Control Office (GCO), subsequently renamed as the Geotechnical Engineering Office (GEO) in 1991, to enact tighter control of geotechnical works in the territory. A core aspect of this was the establishment of a long-term programme called the Landslip Preventive Measure (LPM) programme to deal with sub-standard man-made slopes. The LPM programme ran until 2010 and resulted in the upgrading of more than 4,500 government maintained man-made slopes and retaining walls as well as the safety screening of over 5,000 privately owned slopes. After 2010, the LPM programme was superseded by the Landslide Prevention and Mitigation (LPMit) Programme with an expanded scope to prevent landslide risks from both man-made slopes as well the natural hillsides beyond these.

The government's efforts to reduce the risks from man-made slopes and walls through their systematic study and upgrading under the LPM/LPMit programmes mean that the more notable hazards typically come from the natural terrain hillsides surrounding our developments.

Probably the most significant recent example of this was the rainstorm on 7 June 2008, which had an estimated return period between 500 to 1,000 years and resulted in over 1,000 landslides on Lantau Island alone. These failures blocked several key road links providing the sole access to rural communities on the island and resulted in the emergency evacuation of over 25 village houses.

Sharing lessons

For other parts of the world, a huge amount can be learnt from the way Hong Kong has managed slope and landslide risk. Many governments around the world, especially within the Asia region, are already closely liaising with the GEO and consultants/practitioners in Hong Kong to draw from their experience and knowledge, with the main lesson being that proactive management of landslide risk rather than reactive responses to landslide events is a much more meaningful and effective approach to adopt.

Who knows how bad an event like the 8 September 2023 rainstorm would have been for Hong Kong if we hadn't already had 40 years of detailed slope management in place.

- Stuart Millis is the leader of the engineering geology team for Arup in Hong Kong, where he's been actively involved with landslide studies since 1999. He's also the current chair of the Hong Kong Regional Group of the Geological Society of London and the assistant editor (geotechnical) of the Quarterly Journal of Engineering Geology and Hydrogeology.

(GROUND ENGINEERING, 18 September, 2023, https://www.geplus.co.uk/opinion/a-huge-amount-can-be-learnt-from-the-way-hong-kong-has-managed-landslide-risk-18-09-2023)

Slope Failures in weakly cemented vertical cliffs

Photos taken in August 2002

These photos were taken from The North-West coastline of the Greek Island of Corfu. This side of the island is largely characterized by the vertical slopes as shown in the above Figure. One can easily observe the horizontal layering of the sedimentary material. This material consists of weakly cemented, silt, clay and sand in layers. While travelling along the coastline one can see many failures such as those shown in the Figure above, next to the sea but also in another vertical slope well above the sea level. These failures are largely shallow vertical plane failures caused by stress release fracturing and cantilever block falls. Interesting papers on the failure mechanism of similar slopes along the coast of Northern California are published by Sitar (1990) and J. Hampton (2002). This topic becomes especially important if there are structures at the top of the cliff. Hampton (2002) has an interesting photo of such failure at North Esplanade beach in Pacifica, CA. A similar event of failure can be seen here!

On the below photo you can see that consequent failures lead to a sea-cliff retreat which consists a great hazard for the structure. Already the retaining wall of the garden has been undermined and failed.

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Geo-Legends
Karl Terzaghi (1883 – 1963)

"Soil mechanics is the application of the laws of mechanics and hydraulics to engineering problems dealing with sediments and other unconsolidated accumulations of solid particles." "Few men in a lifetime have exerted an influence on their profession to compare with that of Karl Terzaghi on civil engineering and engineering geology" stated Arthur Casagrande in a memoir honoring his late mentor and friend. Until Terzaghi formally developed the field of soil mechanics, geotechnical engineering relied almost exclusively on experience and guesswork.

The colorful Austrian was born on October 2, 1883 in Prague where his father, Lieutenant-colonel Anton von Terzaghi, was stationed. Instead of following the military tradition of his forefathers, Terzaghi enrolled at the Technical University in Graz and graduated in 1904 with a "Diplom-Ingenieur" (M.Sc.) in mechanical engineering. Upon graduation Terzaghi worked for a Viennese engineering firm that specialized in dams and hydroelectric power plants. Practical experience on projects in Croatia and Russia, combined with a growing interest in geology, exposed Terzaghi to the gaps in knowledge between the geological conditions underlying construction projects and the engineering consequences resulting from these conditions.

After completing his doctorate degree in technical sciences in 1912 and a brief visit to the United States to explore the limited advances in earthwork engineering, Terzaghi returned to Europe as war broke out, serving two years as commanding officer of an aeronautical testing station near Vienna. In 1916 he was transferred to Constantinople to become a professor of foundation engineering at the Imperial Ottoman School of Engineering and later at Bogazici University. It was in Turkey that the young engineer first attempted to quantify the properties of the vast spectrum of soils by means of systematic experimentation. His findings were published in his seminal 1925 work Erdbaumechanik auf Bodenphysikalischer Grundlage (*Earthwork Mechanics based on the Physics of Soils*) which contained the fundamental differential equation for the consolidation process associated with clay compression, an equation analogous to the diffusion equation governing the time-dependent flow of heat in solids. The book also contains the theory of effective stress to explain the behavior of soils under loads. The success of the book led to positions at MIT and the Technical University of Vienna.

Although Terzaghi's ideas were met with skepticism in some civil engineering circles, he continued to write, lecture, and demonstrate the validity of his concepts by their practical application. As momentum within the new discipline grew during the 1930s, Terzaghi's disciple Arthur Casagrande organized the International Society of Soil Mechanics and Foundation Engineering. Terzaghi was elected the society's first President. Hitler's occupation of Austria brought Terzaghi and his family permanently to Harvard, where between 1938 and 1960 he would write two books and publish over 100 papers on topics ranging from the stability of slopes and conditions for the failure of soils to vibration problems and drainage mechanics. During the same period, Terzaghi's consulting work extended to earth dams, the stabilization of landslides, foundations for buildings, waterfronts, highways and airports. His second wife and geology PhD, Ruth Doggett, became a trusted associate and often accompanied Terzaghi on these consulting trips. Karl Terzaghi remains the only engineer to receive the Norman medal four times, the highest award of the American Society of Civil Engineers.

https://www.asce.org/about-civil-engineering/history-and-heritage/notable-civil-engineers/karl-terzaghi

Geo-Legends
Arthur Casagrande (1902 – 1981)

As one of the pioneers in the area of earth fill dam design, the name Arthur Casagrande cannot be separated from that of his fellow countryman, mentor, and colleague, Karl Terzaghi. Together, Casagrande and Terzaghi built the influential discipline of soil mechanics and were personally responsible for the application of their groundbreaking theories to hundreds of large-scale construction projects in America and abroad.

Arthur Casagrande was born in the Italian section of the Austria-Hungary Empire in 1902. Arthur was a violin prodigy as a child, but as he matured his interests shifted from music to engineering. He received his education in civil engineering with an emphasis on hydraulics. Upon completion of his studies he headed to America and became a steel detailer and draftsman for Carnegie Steel in New Jersey. In the summer of 1924 while visiting the Massachusetts Institute of Technology to apply for position in hydraulic engineering, Casagrande met Karl Terzaghi by chance. After the two countrymen discussed Terzaghi's new book, Erdbaumechanik auf Bodenphysikalischer Grundlage ("Earthwork mechanics based on the physics of soils"), Terzaghi asked Casagrande to serve as his research assistant on a consulting project for the U.S. Bureau of Public Roads. During his two years working with the Bureau, Casagrande focused on soil classification, shear testing and frost action in soils.

Though Casagrande did not hold a doctorate, he became a full time lecturer at MIT in 1926. He would also informally serve as his mentor's representative in America after Terzaghi took a position at the Technical University of Vienna. In 1932 Casagrande accepted an assistant professorship at Harvard University. That same year Terzaghi encouraged Casagrande to come to the Technical University of Vienna and obtain his doctorate in engineering science. This entailed sitting for his oral doctorate exams, which Terzaghi chaired, and submitting the work already completed at MIT. Returning to Harvard with his doctorate, Casagrande initiated a program in soil mechanics, which would eventually grow into the prestigious soils engineering group at Harvard. In 1936 he organized the First International Conference on Soil Mechanics and Foundation Engineering, and used the event to highlight the work of his friend and mentor. After the conference Casagrande negotiated a temporary position at Harvard for Terzaghi, a temporary position that would turn into 25 years of collaboration between the two men. In 1936 Casagrande also published his influential paper on the characteristics of cohesionless soils affecting the stability of slopes and earth fills. The paper addresses the problem of liquefaction, a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other rapid loading. Casagrande's fundamental research eventually led to the formulation of criteria and tests that defined the growing understanding of soil behavior under load.

Because of the real world applications of Casagrande's work, much of his career was spent consulting on a variety of large-scale construction projects. During World War II the Army Corps of Engineers and Bureau of Reclamation commissioned Casagrande to derive a unified classification system of soils. Other projects included an analysis of soil mechanics in the design and construction of Boston's Logan Airport, the foundation designs for hydropower dams on three continents, and the report to the U.S. Department of the Interior on the failure of Teton Dam in Idaho. Casagrande served as President of the International Society of Soil Mechanics and Foundation Engineering from 1961 to 1965. Fittingly, he was the first recipient of the Karl Terzaghi Award presented by the American Society of Civil Engineers.

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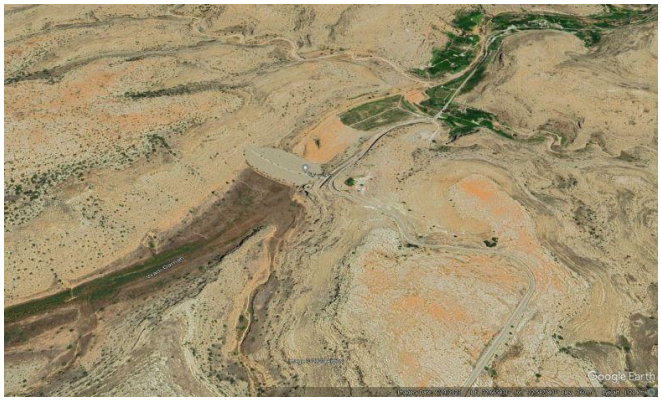
https://www.asce.org/about-civil-engineering/history-and-heritage/notable-civil-engineers/arthur-casagrande

The failed dams in Wadi Derna in Libya

Information is now emerging about the two dams that collapsed to cause the devastating floods in Libya

As the devastation caused by the catastrophic flooding in the port city of Derna in Libya becomes clear, the media has focused on the damage to the urban area and the appalling stories of loss. Before and after satellite images are now available, together with some mobile phone imagery, that illustrate the scale of the catastrophe. There is no doubt that the magnitude of the damage indicates that this was far more than a rainfall-induced river flood, with the finger of blame being pointed at two dams upstream of the city in Wadi Derna (also spelt Darnah in some places).

The two dams are clearly visible on Google Earth. The first is located at 32.658, 22.578:-



The upper (Al-Bilad) dam in Wadi Derna, as shown on Google Earth. Image from June 2023.

The second is about 1 km above the city at 32.752, 22.631:-

The lower (Abu Mansour) dam in Wadi Derna, as shown on Google Earth. Image from June 2023.

There is an article in Arabic on the News Libya website that explains the history of the dams. It notes that Derna has been subject to a sequence of floods emanating from the Wadi, including major events in 1941, 1959 and 1968. The 1959 flood appears to have been particularly catastrophic.

So, in the 1960s studies indicated that the dams should be constructed to protect the city. The dams were constructed in the 1970s by a Yugoslavian company. The upper dam was called the Al-Bilad Dam, with a storage capacity of 1.5 million cubic metres of water, whilst the lower dam, the Abu Mansour Dam, had a storage capacity of 22.5 million cubic metres. The dams had a core of compacted clay with a carapace of stone.

Planet imagery is now available showing the sites of the two dams after the disaster. This is the upper (Al-Bilad) dam:-

Satellite image of the site of the Al Bilal Dam in Wadi Derna, Libya. Image copyright Planet, used with permission. Image dated 12 September 2023.

The image clearly shows that the dam has indeed collapsed and been washed away, and that a large flood occurred downstream. The indications are that this was a catastrophic failure.

The lower (Abu Mansour) dam has also been lost, although the Planet image is currently partially obscured by cloud:-

Satellite image of the site of the Abu Mansour Dam in Wadi Derna, Libya. Image copyright Planet, used with permission. Image dated 12 September 2023.

The most likely scenario is a cascading hazard in which the first dam was overwhelmed and collapsed, releasing a torrent of water and sediment downstream. This would have mixed with water in the channel to overwhelm the lower dam, which clearly collapsed catastrophically too. This scenario needs further study.

The location of the lower dam just 1 km upstream of the city was a contributing factor. Such a short distance meant that the flood had almost no opportunity to dissipate, so Derna received the full force of the torrent.

Work is now needed to understand the causes of the disaster. Clearly the rainfall associated with Storm Daniel was extreme – over 200 mm has been reported. This large total might have exceeded the design capacity of the structures. It will be interesting to see whether this total can be attributed to climate change. Derna suffered floods in 1986, but the dams succeeded in managing the water to avoid serious damage to the city. It will be key to compare the 2023 event to previous storms.

There are also claims that maintenance of the dams might have been deficient. These are comparatively old structures (50 years), so are likely to have needed attention.

Finally, of course, a population that has been subjected to conflict and a failed government will have had a high level of vulnerability, which will increase the death toll.

It is worth noting that Derna is now unprotected from further flood events. However, mustering the resources to rebuild the dams is likely to be very difficult given the state of civil society in Libya.

(Dave Petley / THE LANDSLIDE BLOG, 13 September 2023, https://eos.org/thelandslideblog/the-failed-dams-in-wadi-derna-in-libya)

Libya dam collapse: engineering expert raises questions about management

Satellite imagery after the catastrophic flooding that struck the city of Derna. Satellite image (c) 2023 Maxar Technologies/Getty Images

More than 11,000 people have been killed and tens of thousands are missing following the catastrophic collapse of two dams in the eastern Libyan city of Derna. The dam collapse came after an extreme storm, Storm Daniel, slammed into the north African country. The Conversation Africa's Moina Spooner asked water resources and engineering expert Nadhir Al-Ansari, who has researched the design and safety of dams, to provide insights into the disaster.

How does extreme weather affect the stability of dams?

Dams are usually built to withstand heavy rainfall or drought. The design and construction of a dam takes into consideration all possible effects. All factors, including the type of building materials, the design of the foundation and the stability of a dam, as well as expected floods and earthquakes and even military action, are taken into consideration when planning a dam.

Aside from how the dam is constructed, there should be safety provisions in place. For instance, in cases of storms, the engineers should release the water to ensure that a dam's maximum carrying capacity is not exceeded.

In the Libyan case, I believe that the management of the dams was not good. The engineer responsible for the dam should have made sure the water did not exceed the dam's upper carrying capacity. When he noticed that a huge volume of water was entering the reservoir he should have released large quantities of water to keep its level lower than the upper limit.

Research (https://www.researchgate.net/publication/342270305_Dam_Safety_General_Considerations) shows that the main causes of dam failure are foundation problems (40%), inadequate spillway (23%), poor construction (12%) and uneven settlement (10%). A site for a dam will not always be level because dams are built in mountain areas, but the designers must take that into consideration. The dam design must suit the topography. Among the rarer causes of dam failures are acts of war (3%), defective materail (2%) and earthquakes (1%).

In Libya's case, bad management appears to have been the cause of the dam's collapse.

Could this tragedy have been avoided?

Yes, if the responsible people operating the dams had opened the gates to release water. When those responsible for the water management of the dam ignore heavy rainfall then one can expect such disasters to occur.

Dam managers should also know each dam's catchment area and how much rainfall is forecast. This requires coordination between meteorologists and the staff responsible for the management of dams. When heavy rainfall is expected, the meteorology department should inform dam managers who can then make arrangements for the release of water to keep it within the dam's operational limits. This is the usual practice in all the dams I've studied in Iraq.

In this case, there must have been a breakdown in communication between meteorological department and engineers managing the dams.

How do engineers and authorities typically monitor the structural integrity of dams?

Dams should have a regular inspection programmer that takes into consideration all parts of the dam. All countries with dams, whether in the US, Iraq or Sweden, have regular inspections. There should be instruments for monitoring cracks in a dam's walls and any changes in its structure. Once identified, they must be attended to immediately.

In Libya's case, if they had opened the sluice gates to keep water within the dam's carrying capacity, the collapse of the dams would have caused less damage.

Are there emerging technologies or innovations to improve safety?

There are a number of models and techniques and each dam has its own model or technique that the designer suggests. Planning for extreme weather events is usually done at the design stage of the dam. The designer is meant to give a thorough report on the stability of the dam against various factors, including weather.

Different scenarios are given according to the water level in the reservoir of the dam to prevent dam failure. The government concerned should know what to do in case of dam failure, guided by the design information. For instance, in my study of Iraq's Mosul dam, which took place after the dam was constructed, I suggested that a protection dam be built downstream to secure the safety of the downstream area and its population. Safety steps can be taken even after construction of the dam.

The other safety measures relate to housing and other developments in areas downstream. In Libya's case, there was poor planning. The areas downstream from the dams should not have been used for housing.

Ultimately, the dam failure in Libya could have been prevented, or at least the losses could have been minimized, if the engineers on site had released the water from the reservoir once the storm started.

(Nadir Al-Ansari / THE CONVERSATION, September 15, 2023, https://theconversation.com/libya-dam-collapse-engineering-expert-raises-questions-about-management-213546)

Comparing vulnerabilities of CFRDs and ECRDs

Martin WIELAND

Concrete-faced rockfill dams (CFRD) have been the preferred dam type for high embankment dams for almost fifty years. They are claimed to be the safest dam type by their proponents. Here, Martin Wieland discusses the vulnerabilities of CFRDs and provides a comparison with earth core rockfill dams (ECRD) – the dam type which was replaced by CFRDs

In recent years concrete-faced rockfill dams (CFRDs) have been built in increasing number as an economic alternative to conventional earth-core rockfill dams (ECRDs). Several of these dams already completed or under construction have heights exceeding 150m. CFRDs are also built in seismically active regions. They have been claimed to be the safest dam type by their developers. Today, such claims are also made for asphalt core rockfill dams. The two basic failure modes of embankment dams are progressive erosion due to overtopping and internal erosion.

Protection against overtopping can be provided by an adequate freeboard, by widening and strengthening the crest, by wave walls on the crest, etc. In composite dams consisting of a concrete section and embankment sections or dams with saddle dams, the overtopping risk of the embankment dam and the saddle dams, which are usually embankment dams themselves, can be reduced by increasing their height (Figure 1) so that in the worst case the concrete section of a composite dam will be overtopped dam, but not the vulnerable embankment dams.

Figure 1. Detail of transition in crest elevation between concrete dam section in the foreground and rockfill dam in the background to prevent overtopping of the rockfill dam section (Kenering dam in Malaysia, a composite concrete gravity dam with two rockfill dams at abutments)

Maximum overtopping depths of up to about 2m may be accepted for concrete dams. However, the sliding stability of overtopped dams must be checked. This may be a safety problem for small gravity dams, but usually not for high concrete dams. In storage schemes comprising a main dam and saddle dams, one of the saddle dams could be used as a fuse plug or emergency spillway and the crest elevations of the other dams forming the reservoir should be higher than that of the fuse plug.

Using adequate filters embankment dams can be protected against internal erosion. Due to seismic deformations or slope failure the filter may be damaged. Dams with thin filters, whereby many of them are older dams, are vulnerable to such deformations.

As dams may be subjected to many different hazards from the natural and man-made environments as well as site-specific and project-specific hazards (Wieland, 2023), which may affect dams in different ways, it is too soon to maintain that certain dam types are safer than others. For example, a comparison of different dam types (CFRD, ECRD, gravity dam and arch dam) subjected to the multiple hazards associated with strong earthquakes, i.e. ground shaking, movements of faults or discontinuities in the footprint of dams and rockfalls at the dam site, was made by Wieland (2016). This qualitative comparison showed that for the abovementioned seismic hazards the best solution would be a conventional ECRD, as CFRDs would be vulnerable to fault movements, rockfalls on the face slab and ground shaking due to the different deformational and strength properties of the concrete face and the rockfill. However, the damage to the face slab due to rockfalls could be prevented by rockfall nets and other protective measures and the problems caused by the different deformational behaviour of the concrete face and the rockfill could be overcome by using rockfill with a high modulus of elasticity and by providing adequate vertical and horizontal joints in the face slab.

Because of the high permeability of rockfill, CFRDs should not fail if leakage through the face slab occurs, which also applies to asphalt core rockfill dams. However, in order to achieve a high stiffness of the rockfill, the grain distribution must include a fraction of relatively fine particles, which influences the permeability of the rockfill and a water table may develop near the base of the dam, depending on the amount of leakage through the concrete face, i.e. mainly through the joint sealing system.

The primary objective of this paper is to discuss the main factors, which could damage the concrete face, the joints between concrete slabs, waterstops and the plinth, and to provide recommendations on how these damages may be prevented or minimized.

One must also keep in mind that like other dams, CFRDs are prototypes, therefore generalizations are difficult and the damage that could occur in one dam may not occur in another one.

Failure or near-failure of CFRDs

The performance of CFRDs have been discussed by Marulando and Marulando (2008). They listed several high CFRDs, in which damage occurred in face slabs. Based on these observations, improvements were made in the design of face slabs and the water proofing system of the joints, which also account for larger joint movements as experienced, e.g. under seismic action.

Up to now the following CFRDs have failed: (i) Gouhou CFRD in China due to seepage and internal erosion (Zhang and Chen, 2006) and (ii) Taum Sauk CFRD in the US due to overtopping (ASDSO, 2005).

Gouhou Dam, a 71m high concrete-faced rockfill dam with a crest length of 265m, which was completed in 1990 in Qinghai Province, China, stored a reservoir with a volume of 3.1Mm^3. Reservoir impoundment started during the construction of the dam and when it was completed the reservoir level was 3.9m below the normal water level and seepage flow was observed in the downstream slope. When the reservoir level reached a maximum on August 27, 1993, seepage increased and caused failure of the dam. About 320 people were killed due to the catastrophic release of the reservoir water. The main reasons for this incident were the leakage through the horizontal joint of the concrete face and the par-

apet wall structure on the dam crest, and rockfill materials that were susceptible to internal erosion.

The embankment dam forming the upper reservoir of the Taum Sauk Pump Storage Plant in Missouri, US, completed in 1962 and failed on December 14, 2005, due to pumping when the reservoir was full, causing overtopping of the dam and progressive erosion and dam failure (Figure 2). Fortunately, nobody was killed in the flood wave resulting from the dam`s failure, but the damage was estimated at US$1 billion.

Figure 2. View of breach of shotcrete CFRD of upper reservoir of the Taum Sauk Pump Storage Plant caused by overtopping (ASDSO, 2005)

The embankment dam of the Upper Reservoir, was made of dumped, uncompacted rockfill. The inside of the reservoir was lined with shotcrete. In 2004, a geomembrane liner was installed to reduce the leakage through cracks in the shotcrete caused by differential settlements (ASDSO, 2005). Because this shotcrete liner was the water proofing element of this dam it is considered to be a type of CFRD, although this face slab has little in common with that of the CFRDs built today.

The main reasons for this dam failure were deficient water gauges, so that the operator was not aware that the reservoir was full and with the absence of any spillway. Although there was no inflow into the upper reservoir, a spillway with a minimum discharge capacity equal to the maximum pump capacity would be needed.

The failure of the Gouhou CFRD may be considered as representative for the internal erosion failure mode and the failure of the Taum Sauk CFRD as representative for the overtopping failure mode.

In 2014 the 90m high Tokwe Mukosi CFRD in Zimbabwe, which stores a reservoir with 1.75km^3, nearly failed during a severe flood in February 2014, when the dam was still under construction and the upstream concrete face was not yet built. Severe seepage occurred as shown in Figure 3 as no waterproofing membrane was in place.

Figure 3. Seepage through Tokwe Mukosi CFRD during a severe flood in 2014 in Zimbabwe, when the dam was still under construction and the concrete face was not yet in place (CC BY 4.0)

With some delays the dam was completed and was commissioned in 2017. This important case study shows that excessive seepage through the rockfill can endanger the safety of CFRDs and that they may not be inherently safe as claimed by the designers of these dams. Of course, this also applies to rockfill dams with other types of upstream membranes, such as asphaltic concrete membranes or geomembranes or asphalt core rockfill dams.

Regarding the load bearing behaviour of CFRDs or other dams with an upstream waterproofing membrane, the transfer of the water load to the foundation rock is much more efficient than in the case of ECRDs, asphalt core rockfill dams or dams with a concrete core wall.

The main advantage of CFRDs is the significantly smaller dam volume than a comparable ECRD as the upstream and downstream dam slopes are generally steeper than those of ECRDs. ECRDs also require large quantities of core materials, which may not be readily available at some sites.

However, in this paper, the focus will be on safety aspects of CFRDs and the weakest element in CFRDs is the concrete face, which must be watertight. In this discussion, the benchmark will be conservatively designed CFRDs, which may be considered to be the most resilient embankment dam type. But we must keep in mind that all embankment dams are vulnerable to overtopping and, therefore, as a prerequisite these dams must have adequate flood discharge outlets. Today, the safety flood for embankment dams is the PMF (probable maximum flood), which must be released under the following assumptions:

- The power plant is out of operation, i.e. no discharge through power waterways.
- The outlet (spillway opening or low-level outlet) with the largest discharge capacity is closed. In dams with several spillway openings more than one opening has to be assumed to be closed.
- The maximum water level in the reservoir shall not exceed the top of the impervious core of ECRDs. For CFRDs the reservoir level may be up to the dam crest. Special criteria may apply to account for waves in the reservoir and storm surges in large reservoirs.

The present discussion also applies to saddle dams, whose failure has similar consequences to the failure of the main dam. If the same safety criteria have to be applied to the levees of run-of-river power plants as for saddle dams, this is not addressed in this paper because levees may be considered to be a kind of saddle dam.

We must also recognize that a dam with a long economic and safe life requires a good design, good quality of all construction works, regular maintenance and continuous safety monitoring.

Hazards affecting CFRDs

The hazards affecting the safety of all types of dam were discussed by Wieland (2023). The main hazards relevant for CFRDs can be classified as follows:

1. **Natural hazards:**

- Flood hazard (overtopping of dam, sedimentation of reservoir or blocking of spillway by floating debris).
- Earthquake hazard (inelastic deformations of dam body due to ground shaking or deformations in the dam footprint).

- Mass movement at dam site (damage of dam crest and concrete slabs).
- Mass movement into reservoir (impulse wave causing overtopping of dam).
- Water waves in reservoir (damage of riprap at the upstream face of ECRDs, local destabilisation of reservoir slopes).
- Temperature effects (cracking of concrete slabs and corrosion of reinforcement).

2. Man-made hazards:

- Design errors, low quality construction works and lack of or faulty maintenance, etc.
- Terrorism and acts of war.

3. Project-specific hazards:

- Dam geometry and layout of face slab with plinth.
- Ageing of face slab (cracking and corrosion of reinforcement) and waterstops.
- Effect of inelastic static and seismic deformations of the dam body on in-plane stresses in the face slab, taking into account the arrangement and detailing of the joints.
- Temperature effects on face slab especially in drying-wetting zone of the face slab.
- Permeability of rockfill and vulnerability to internal erosion, etc.
- Physical degradation of rockfill, collapse settlement, stiffness of rockfill, etc.
- Modifications in dam body and repair works.

4. Site-specific hazards:

- Topography and geometry of dam body.
- Geology (permeable rock, clay interfaces in foundation, karst, etc.) and local site conditions (soil cover, liquefiable material, etc.).
- Seepage in foundation and arrangement of grout curtain or cut-off wall.
- Effect of changes in the ground water table due to reservoir impounding on slope stability, weakening of rock or causing differential foundation movements, etc.

This list is quite exhaustive. Item (3) is mainly related to CFRDs and the face slab, whereas the other items apply to both CFRDS and ECRDs as well as to other types of embankment dam. However, these hazards – many of which are time-dependent – have different effects on CFRDS and ECRDs. In general, the safety implications of these hazards for ECRDs and other conventional embankment dams are quite well understood, but the long-term behaviour of CFRDS and other new types of dam is less well understood as they may not yet have experienced extreme or unusual events. Therefore, in future some dams may have to be upgraded and the design and safety criteria, etc. must be updated. These periodic safety reviews are standard practice in the dam industry. They also include the time-dependent effects of climate change hazards.

It is not the intention to discuss each of the above hazards and its effect on the safety of the face slab of CFRDs as every dam project is unique since in terms of dam safety the priority order of hazards varies.

The main safety aspects of the concrete face discussed in the subsequent sections are as follows:

- Observed damage in face slabs.
- Different deformational behaviour of rockfill and the reinforced concrete of the face slab.
- Detailing of joints in the face slab.

Different hazards may contribute to these items.

Because earthquakes may produce the largest stresses and deformations in all types of dams, emphasis will be put on this extreme load case in the subsequent sections. The seismic load combination also includes the usual static loads such as dead load, water load and silt load. Therefore, if a dam is structurally safe for the seismic load combination, it will also be safe for the static loads. This also applies to CFRDs. Wieland (2010) and Wieland and Brenner (2007) have discussed different seismic safety aspects for CFRDs. The present paper is basically an extension of these papers as new information has become available and several high CFRDs have been built or are under construction. In China, there are plans to build CFRDs with heights up to 300m, in which seismic performance and safety aspects will play an even greater role in the future. Extreme man-made effects such as terrorism and acts of war are not discussed. Face slabs could be damaged by such actions quite easily.

For the safety assessment of dams, the extreme seismic load combination must be analysed. This means that the recent failures of old water storage dams in the US and tailings dams in Brazil and Australia, which were attributed to static liquefaction, would never have been declared safe if the extreme seismic load combination had been considered in the safety analyses.

Observed damage of face slabs of CFRDs and damage analysis

Damage to face slabs has been observed at different CFRDs, mainly for very high dams. The main reasons for the damage, which also caused an increase in the seepage through the dam body, may be summarized as follows:

- Leakage of joints in the face slab due to inadequate joint detailing and installation of waterstops.
- High in-plane stresses in face slab due to deformations of rockfill causing damage of joints and cracks in face slab, when the biaxial strength of the reinforced concrete slab is exceeded.
- Impact damage of slab elements close to abutments due to rockfall.
- Shrinkage and thermal cracks in concrete slabs resulting in accelerated corrosion of reinforcement in face slab.

Typical damage along vertical and horizontal joints in the face slab of the 156m high Zipingpu CFRD in China are shown in Figures 4 and 5. This damage was caused by the ground shaking during the magnitude 8 Wenchuan earthquake of May 12, 2008. The concrete spalling along the vertical joint was the result of large normal stresses and the detailing of the joint (Figure 4). It is interesting to note that the joint damage is all along the joint despite the fact that the thickness of the concrete slab increases linearly from the top to the bottom of the dam. This means that the high compressive stresses in the face slab are almost independent of the slab

thickness. This is typical for structural elements subjected to imposed deformations like, e.g., restrained temperature strains. Unlike the overthrust displacement shown in Figure 5, there is no such component visible along the damaged joint in Figure 4.

Figure 4a. Damage to vertical joint of Zipingpu CFRD caused by the 2008 Wenchuan earthquake in China (4a) and the repair of a damaged vertical joint (4b). During the earthquake the reservoir volume was about 30% of that due to normal water level (photos courtesy Xu Zeping)

Figure 4b. Damage to vertical joint of Zipingpu CFRD caused by the 2008 Wenchuan earthquake in China (4a) and the repair of a damaged vertical joint (4b). During the earthquake the reservoir volume was about 30% of that due to normal water level (photos courtesy Xu Zeping)

Figure 5a. Damage of horizontal joint of Zipingpu CFRD caused by the 2008 Wenchuan earthquake in China (photos courtesy Xu Zeping)

Figure 5b. Damage of horizontal joint of Zipingpu CFRD caused by the 2008 Wenchuan earthquake in China (photos courtesy Xu Zeping)

The damage to the horizontal joint with the vertical offset and the overthrust displacement is due to the differential movement of the slab support caused by the deformations in the rockfill, which cannot be prevented by the face slab (Figure 5).

The basic structural function of the face slab is to transfer and distribute the water load over a larger area and to compensate for any variations in the stiffness of the rockfill support. Therefore, for the hydrostatic and hydrodynamic loads the face slab will experience some bending moments due to nonuniform rockfill deformations. These bending moments are rather small and will cause cracks as in reinforced concrete structures. In order to ensure watertightness the crack width should be less than 0.1mm. This is a serviceability limit state problem and not a strength problem.

In Figure 6 shrinkage cracks in the face slab of the 182m high Nam Ngum 2 CFRD in Laos are shown. All visible cracks were repaired to minimize any leakage through the face slab and to protect the steel reinforcement from corrosion. Steel reinforcement was provided at the top and bottom of the concrete slab. The development of a shrinkage crack can be avoided by using fibre reinforced concrete for the face slab, which increases the tensile strength of concrete.

Figure 6. Repaired shrinkage cracks in the face slab of the Nam Ngum 2 CFRD in Laos

Discussion and analysis of damage mechanisms of face slabs

The observed damage to the face slabs above the reservoir level was the result of high in-plane stresses and was not caused by the water load. These stresses are due to the different deformational behaviours of the rockfill and the concrete slab. The modulus of elasticity of rockfill may be of the order of 100 MPa, whereas that of concrete under seismic action may be 30-40 GPa, which is a factor of 300 to 400 times larger than that of rockfill. Therefore, if the rockfill portion of the dam deforms, it is partly restrained by the face slab and thus the shear stresses are mobilized along the rockfill-face slab interface. The shear stresses are limited by the friction between the face slab and the rockfill, which depends on the normal stresses due to the dead load of the face slab and the water load. The friction forces are relatively small for the face slabs above the reservoir level and increase almost linearly with increasing water depth in the submerged part and therefore the in-plane stresses will be much larger in the submerged part of the face slab than in the part above the reservoir level.

The in-plane stresses in the face slab are caused by the deformations of the rockfill support and such stresses are also known as stresses due to imposed deformations, similar to temperature, shrinkage and creep strains. These imposed strains can be released by joints or cracks. Therefore, if an adequate joint spacing and joint width between adjacent concrete slabs is provided, these strains can be reduced significantly. Therefore, if concrete spalling is observed along joints and cracks in face slabs, it can be assumed that the joints are closed and compressive stresses can be transferred from one slab to the other, i.e. the face slab acts almost as a monolithic plate subjected to compressive stresses. In the case of tension, the joints will open.

Usually, the selection of the joint width is based on the assumed static deformations of the body of the rockfill dam, which along the crest provide tension zones near both abutments and compression in the centre of the crest. To minimize in-plane stresses due to such deformations the joint width in the compression zone should be increased. This concept works for static deformations, i.e. dead load and water load, however for seismic action the joints can be closed or open because of the oscillatory nature of the ground motion. Therefore, dynamic compressive stresses will occur even in static tension zones when the joint is closed. These compressive stresses may damage the joints when they reach the values of the compressive strength of concrete, which are of the order of 30 MPa. Cracks may also develop when the biaxial strength of the face slab is exceeded in zones with principal stresses in tension and compression rather than under biaxial compression. Inclined cracks are due to high shear stresses.

If cracks develop or a joint is damaged due to high compressive stresses, then in the case of imposed deformations or seismic action the other parts of the face slab and the other joints will be protected from similar damage. This is also an observation made when tensile cracks are formed in concrete dams due to seismic action.

Therefore, in order to protect the face slab from damage, it is recommended that the width of the vertical joints is determined in such a way that they will not be closed under seismic action. For this purpose, a three-dimensional dynamic analysis of the CFRD is required.

As the slopes of CFRDs are usually much steeper than those of ECRDs, the seismic deformations in the crest region of CFRDs (horizontal displacements) are much larger than in other types of embankment dams of similar height and with much flatter slopes. These deformations may create further damage in this part of CFRDs, although this has not yet been observed; but up to now only few CFRDs were exposed to strong ground shaking.

Consequences of damage to the face slab of CFRDs

The consequences of damage to face slabs, i.e. joint leakage and leakage through cracks in the face slabs, are an increase in seepage through the dam. The amount of leakage depends, on the one hand, on the crack width and the hydrostatic pressure, which is maximum at the base of the dam, and, on the other hand, on the seepage through the joint system.

Leakages as high as several m^3/sec were observed in dams with damaged face slabs or defect waterstops. For example, for the 92m high Vajiralongkorn (Khao Laem) CFRD in Thailand the maximum seepage was $2m^3$/sec and for the 202m high Campos Novos CFRD in Brazil the seepage reached $11m^3$/sec.

In the case of Zipingpu CFRD, which suffered some face slab damage as shown in Figures 4 and 5, the maximum seepage depends on the reservoir level and was about 50 l/s for the maximum reservoir level. At the time of the earthquake the reservoir volume was only about 30% of that at the full supply level. Therefore, before the earthquake the seepage was about 10 l/s, which increased shortly after the earthquake to 19 l/sec. This means that the damage caused in the submerged lower portion of the dam was minor.

In general, leakage through the cracked face slab and joints should not be a dam safety issue, but there are cases where excessive leakage has caused severe safety problems. One of the problems may be the use of low quality erodible rockfill.

Damage to the face slab may be higher near the crest due to increased seismic deformations in this zone. Special measures may be required, but the most effective means is by providing flatter slopes of the CFRD. In highly seismic zones the slopes could be 1:1.5 or even 1: 1.6, which is much flatter than a value of 1:1.3 used in zones of low seismicity. These high crest deformations are also a problem of other types of impervious elements (e.g., asphalt cores or concrete core walls), when slope failures near the crest could occur.

Conclusions

The main conclusions of the discussion of different safety aspects of CFRDs and their comparison with ECRDs are as follows:

1. CFRDs are vulnerable to overtopping like all types of embankment dams. There are several reasons for overtopping of dams such as inadequate spillway capacity or the malfunction of spillways and/or low-level outlets.

2. The face slab is vulnerable to deformations of the dam body, e.g. due to settlements after construction of the face slab and due to seismic deformations. Such deformations may cause cracking in the face slab or damage to vertical (and horizontal - if any) joints. To minimize deformation of the rockfill, it must have a high modulus of elasticity, i.e. rockfill must be well-compacted and have a proper grading of the particles.

3. It must be checked, if face slab leakage may create safety problems to the dam. Fine material could be washed out causing further dam deformations. In order to minimize deformations of the dam body, the rockfill must be well compacted and must have a high modulus of elasticity (or deformation modulus), which can only be achieved by

well-graded rockfill, i.e. there must be particle breaks during compaction. Rockfill particles with very high strength like basalt or some other types of rock with uniform particle size will result in rockfill of low modulus of elasticity of, e.g., less than 50 MPa, whereas for high CFRDs values exceeding 100 MPa are needed. The breakage of rockfall pieces could mean that the rockfill will not drain as quickly as assumed in the design and could lead to a small rise in water level within the rockfill depending on the amount of leakage through the face slab.

4. The face slab, joint sealing and plinth may be exposed to falling rock near the abutments, and any damage to them may cause local seepage in that part of the dam.

5. The face slab (near the crest) could also be damaged by explosives or the impact of boats.

6. CFRDs could be damaged by strong earthquake ground shaking as in the case of the Zipingpu CFRD in China, during the 2008 Wenchuan earthquake. The detailing of the vertical joints has a major impact on the damage to face slabs under both static and seismic deformations. As the slopes of CFRDs are much steeper than those of ECRDs, the seismic deformations in the crest region of CFRDs (horizontal displacements) are much larger than in other types of embankment dam of similar height and with much flatter slopes. These deformations may create further damage in this part of CFRDs.

7. CFRDs are vulnerable to fault movements in the footprint of the dam and also to non-uniform foundation settlements, especially when the dam is not built on rock.

8. CFRDs may have a shorter lifespan than ECRDs, due to the corrosion of the reinforcement in the relatively thin face slabs. Ultimately, the reinforcement will start to corrode despite a concrete cover of the reinforcement of say 7-10 cm. Most vulnerable are cracked slabs and slabs near the crest, which experience several wetting-drying cycles or even frost cycles.

It may be concluded that face slab leakage is the main safety concern and there is a need to evaluate the effect of this leakage on the safety of the dam body, taking into account that the permeability may be substantially less than assumed in the design.

Martin WIELAND, Dr. sc. techn., Chairman of ICOLD Committee on Seismic Aspects of Dam Design, Dam Consultant, Dietikon, Switzerland and AFRY Switzerland, Zurich, Switzerland

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Note: This paper was originally presented at the XX Technical Dam Control International Conference

(Water Power & DAM CONSTRUCTION, 15 September 2023, https://www.waterpowermagazine.com/features/feature-comparing-vulnerabilities-of-cfrds-and-ecrds-11150911/)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular September 2023

www.issmge.org/news/issmge-news-and-information-circular-September-2023

1. ISSMGE Council Meeting 13th August 2023 Highlights

At the Council Meeting in Astana, Kazakhstan a decision was made to instruct lawyers to produce draft Articles of Association with a view to the ISSMGE becoming an Incorporated Society. Incorporation will establish the ISSMGE as a legal entity and enable the Society to continue to hold bank accounts. The aim is to circulate draft Articles of Association to Member Societies prior to seeking a unanimous vote to proceed with Incorporation late in 2023.

Other key points from the Council Meeting are:

The budget 2023 -2026 was presented by Graham Scholey (VP for Australasia) and received majority support from Council.

The term of appointment of the Secretary General, Professor R Neil Taylor has ended and Professor Taylor has stepped down after 24 years of service receiving thanks from Council, led by the President. Dr Andrew McNamara is now the Secretary General of ISSMGE.

The next in-person Council meeting will be held on the occasion of the quadrennial international conference (21 ICMSGE) to be held in Vienna, Austria 14-19 June 2026.

2. Message from Prof. Pierre Delage, Chair of the ISSMGE Geo-Engineers without Barrier Committee (GeoWB)

Dear Member Society Officers

This is a message from Pierre Delage, former TOC Chair. I am now in charge of a new committee proposed by ISSMGE Pdt Marc Ballouz called Geo-engineers without barriers (GeoWB). The basic idea of the Committee is to do in our domain of geotechnical engineering and natural risks what "Medecins sans frontieres" do for health issues and sanitary disasters in some countries: in link with local ISSMGE Member Societies, relevant organisations and local contacts, to propose to countries affected by geo-disasters to rapidly send some volunteer experts in charge of rapidly providing a short report (3 pages or more). The report would describe the observations and conclusions drawn on the ground (more details here). Geo-disasters may be earthquakes, landslides, floods, failure of dykes, dam and tailing dams, collapse of geotechnical structures, foundations, tunnels...

This message is to let you know the existence of this ISSMGE Committee, within various perspectives:

- Some members of your Member Society (SM) may be willing to act as volunteer expert for some geo-disaster, preferably in a region close to yours.

- Your country might be, unfortunately, affected by some geo-disaster. In this case, it would be good that, if you wish, you inform GeoWB that you would like to have such a support. Note that, in the case you have local experts able to intervene and prepare the report, the ISSMGE could support their travel expenses.

- Your country has close links with a country affected by a geo-disaster but without any SM. Your links with the country and local knowledge (including speaking the local language) would then be quite useful for GeoWB experts (either from your country or from another one, preferably close and from the same region).

Note that the GeoWB committee is still in constitution and that motivated candidates can apply to participate to the GeoWB activities.

The ISSMGE thinks that mobilising our ISSMGE competent worldwide network will definitely help the Society in case of geo-disasters.

Thank you for your help, we look forward to receiving your feedback.

Best wishes,

Pierre Delage

Chair of the ISSMGE Geo-Engineers without Barrier Committee (GeoWB)

3. ISSMGE BULLETIN

ISSMGE is launching a new bulletin edition and the President, Vice-Presidents and all board members are encouraging you to send an article or summary about your completed or planned activities, or special projects in your country, for publication in the next issue. Please send to the ISSMGE Secretariat (secretariat@issmge.org) with a copy to the Editor-in-Chief, Professor Anthony Leung (ceanthony@ust.hk). .

Please keep feeding us with your exciting news regularly so that our bulletin from now on becomes richer and more animated!

The latest edition of the ISSMGE Bulletin (Volume 17, Issue 3, June 2023) is available from the website.

4. ISSMGE FOUNDATION

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 30th September 2023. Click here for further information on the ISSMGE Foundation.

5. CONFERENCES

For a complete listing of all ISSMGE and ISSMGE supported conferences, and full information on all events, including deadlines, please go to the Events page at https://www.issmge.org/events. For updated information

please refer to that specific events website.

The following events have been added or amended since the previous Circular:

ISSMGE EVENTS

GEOTECHNICS FOR OFFSHORE WIND IN JAPAN - 30-10-2023 - 31-10-2023 Institute of Industrial Science, University of Tokyo, Japan; Language: English; Organiser: TC209 and Japanese Geotechnical Society; Contact person: Shinya Tachibana; Address: Kobe University; Email: stachi@people.kobe-u.ac.jp; Website: https://confit.atlas.jp/guide/event/geotechwind2023/top

INTERNATIONAL CONFERENCE ON GEOTECHNICAL ENGINEERING (ICGE'24) - 25-04-2024 - 27-04-2024 Hammamet, Tunisia; Language: English; Organiser: The Geotechnical and Georisk Research Laboratory; Contact person: National Engineering School of Tunis; Address: BP 37 Le Belvédère; Email: contact@icge24.com; Website: http://www.icge24.com;

GEOSHANGHAI 2024 - 26-05-2024 - 29-05-2024 WH MING HOTEL, China, Shanghai; Language: English; Organiser: Tongji University; Contact person: Mingliang Zhou; Address: NO.1239 SIPING ROAD; Phone: 008613918955481; Email: zhoum@tongji.edu.cn; Website: http://www.geoshanghai.org; Email: geoshanghai@tongji.edu.cn

11TH INTERNATIONAL SYMPOSIUM OF GEOTECHNICAL ASPECTS OF UNDERGROUND CONSTRUCTION IN SOFT GROUND (IS-MACAU 2024) - 14-06-2024 - 17-06-2024 Macao SAR, China; Organiser: University of Macau, LECM and TC204 of the ISSMGE; Contact person: ZHENG GUAN; Address: Faculty of Science and Technology University of Macau, E11 Avenida da Universidade, Taipa, Macau, China; Phone: +85388229153; Email: ismacau2024@um.edu.mo; Website: https://is-macau2024.skliotsc.um.edu.mo

5TH INTERNATIONAL SYMPOSIUM ON FRONTIERS IN OFFSHORE GEOTECHNICS (ISFOG) - 09-06-2025 - 13-06-2025 La Cité des Congrès de Nantes, France; Language: English; Organiser: University Gustave Eiffel, CFMS, French Mirror Group of the Technical Committee TC 209; Contact person: Sylvie Bretelle ; Address: 1 rue du Vieux Pont; Phone: 0785428593; Email: s_bretelle@hotmail.com; Website: https://isfog2025.univ-gustave-eiffel.fr/; Email: luc.thorel@univ-eiffel.fr

NON-ISSMGE EVENTS

GEOMATE 2023 - 14-11-2023 - 16-11-2023 Hotel Tsu center Palace, Tsu, Japan; Language: English; Organiser: The Geomate International Society; Contact person: Prof. Dr. Zakaria Hossain; Address: Mie Ken, tsu city, Kurimamachiya-cho 1577; Phone: +81592319578 ; Fax: +81592319578 ; Email: zakaria@bio.mie-u.ac.jp; Website: https://geomate.org/index.html; Email : conference@geomate.org

Call to host the 3rd International Conference on Energy Geotechnics in 2025+

Guillermo Narsilio / TC308 / 03-09-2023

While we prepare ourselves for meeting in Delft in October 2023 for the 3rd International Symposium on Energy Geotechnics (SEG'23), the Technical Committee 308 has made the call for hosting the next International Conference on Energy Geotechnics (ICEGT'25).

The intention is to run the Conference somewhere in the vicinity of 2025, with suggestions to give bidders the option to propose other dates if they see fit. Bidders are encouraged to contact the committee to discuss any aspects of the organisation.

Please click here to access details of the official call and submit your bids by 18 September 2023 6:00 pm UCT to:

Kamelia Atefi Monfared (Secretary)

(Cc: Alessio Ferrari alessio.ferrari@epfl.ch, Guillermo Narsilio narsilio@unimelb.edu.au)

Previous editions took place in San Diego, CA, USA (ICEGT 20-22); and in Kiel, Germany (ICEGT 16), with around 100 to 300 delegates from all over the world.

The 6th ERTC10 Webinar on the Second Generation of Eurocode 7 - Spread Foundations, Retaining Structures and Anchors

Witold Bogusz / ERTC10 / 03-09-2023

The 6th Webinar organised jointly by ISSMGE ERTC10, CEN TC250 SC7 and NEN is open for registration:

Second Generation of Eurocode 7 - Spread Foundations, Retaining Structures and Anchors

Time: Wednesday, **27.09.2023, 15:00-17:00 CEST**

The webinar will be 2h long and it is free of charge.

It will cover aspects of the new Eurocode 7 related to:

- Spread Foundations - by Kerstin Lesny (Germany)
- Retaining Structures - by Thierry Jeanmaire (France)
- Anchors - by Klaus Dietz (Germany)
- Examples of retaining structures - by Stuart Hardy (UK)

Link to the website with the registration form: https://webinar-eurocode7-september2023.nen-evenementen.nl/

A TALE OF TWO EXPLANATIONS

Marina Pantazidou / TC306 / 06-09-2023

The attached file is a summary of the paper accompanying the 3rd Blight Honor Lecture delivered by Alonso (2023) at the 8th UNSAT, titled "**The positive history of an error. Modelling the heave of a nuclear power station**". The summary is meant to play the role of a guided tour and encourage geotechnical engineers to read the paper and watch the lecture, the message of which is relevant to research, practice and education. Many thanks to Prof. Alonso for reading the summary and okaying it.

Read "A tale of two explanations (for heaving claystone)" here.

Education concerns all, hence TC306 is actively pursuing interactions with other TCs. TC306 encourages in particular small-scale contributions, such as reviews, news items on peer reviewed and peer-recommended educational material, short commentaries on geotechnical topics from a teaching point of view. This guided-tour kind of summary is another example of small-scale contribution. **Please bring to TC306's attention other such worthy topics and con-**

sider a coauthored contribution.

ISSMGE Interactive Technical Talk Episode 9: Machine Learning and Big Data (TC309)

ISSMGE IT Administrator / TC309 / 07-09-2023

The ninth episode of International Interactive Technical Talk has just been launched and is supported by TC309. Dr. Zhongqiang Liu, Dr. Kok-Kwang Phoon, Dr. Tatiana Richa and Dr. Sara Khoshnevisan are discussing with Dr. Marc Ballouz about Machine Learning.

Watch ISSMGE Interactive Technical Talks

ISSMGE Interactive Technical Talk Episode 10: Field Monitoring in Geomechanics (TC220)

ISSMGE IT Administrator / TC220 / 21-09-2023

The tenth episode of International Interactive Technical Talk has just been launched and is supported by TC220. Dr.-Ing. Giorgio Pezzetti, Dr. Neelima Satyam D. and Emma McConnell are discussing with Dr. Marc Ballouz about "Field Monitoring in Geomechanics".

Watch ISSMGE Interactive Technical Talks

Proceedings from the 10th European Conference on Numerical Methods in Geotechnical Engineering available in open access

ISSMGE IT Administrator / General 22-09-2023

The Innovation and Development Committee of ISSMGE is pleased to announce that through the initiative of Prof. Lidija Zdravkovic, Prof. Stavroula Kontoe, Dr. Aikaterini Tsiampousi and Dr. David Taborda.

The 267 papers from the proceedings of the 10th European Conference on Numerical Methods in Geotechnical Engineering (NUMGE2023) are available in the ISSMGE Online Library here:
https://www.issmge.org/publications/online-library?database=51&conference=119

The abstracts and papers of the proceedings were reviewed through ISSMGEs Conference Review Platform which is part of its cyber-infrastructure aiming to support open access.

NUMGE2023 was held in London, United Kingdom from June 26th to June 28th in 2023 at the Imperial College London. Detailed acknowledgements for the NUMGE2023 can be found at the ISSMGE online library acknowledgements section.

ICSE-11 proceedings now available

Shinji Sassa / TC213 / 22-09-2023

All papers of ICSE-11 (The 11th International Conference on Scour and Erosion) proceedings are now available at Online Library | ISSMGE.

TC213 Committee Meeting, Sep. 18, 2023

Shinji Sassa / TC213 / 22-09-2023

The full agenda items for the TC213 Committee Meeting on September 18, 2023 are available here: https://www.issmge.org/filemanager/article/1176/Full_Agenda_Items_for_the_TC213_Meeting_at_ICSE-11.pdf

Proceedings from the 8th International Symposium on Deformation Characteristics of Geomaterials available in open access

ISSMGE IT Administrator / General / 25-09-2023

ISSMGE is pleased to announce that the 148 papers from the Proceedings of the 8th International Symposium on Deformation Characteristics of Geomaterials (IS-Porto 2023), are available in the ISSMGE Online Library here:

https://www.issmge.org/publications/review-platform/conferences/isdcg2023

IS-Porto 2023 was held in Porto, Portugal from the 3rd to the 6th September 2023.

The papers of the proceedings were reviewed by at least two reviewers, through the ISSMGE Conference Review Platform, to ensure the high quality of the contributions. The Editors are António Viana da Fonseca and Cristiana Ferreira. The Associate Editors are António Alberto Correia, Castorina Vieira, Graça Lopes, Fausto Molina-Gómez, Mafalda Lopes Laranjo, Nuno Raposo, Paulo Coelho, Rafaela Cardoso and Sara Rios.

Detailed acknowledgements can be found at the ISSMGE Online Library acknowledgements section.

ISRM International Society for Rock Mechanics and Rock Engineering

News
https://www.isrm.net

ISRM Young Members' Seminar 2023-09-02

The next ISRM Young Members' session will be held next Thursday, 7th of September at 3 pm GMT and it will be on rock fall phenomena, use of numerical method in rock engineering and micro to macro rock properties. The seminar is

free for public. Don't miss it: follow the link in the flyer to register.

The ISRM Young Members' Seminar (YMS) Series is an ISRM Young Members Group initiative: a series of virtual events to provide a global platform for ISRM young members to share knowledge, experiences, and ideas. More info on the YMS is available here.

1st SLRMES Conference on Rock Mechanics for Infrastructure and Geo-resources Development, Colombo, Sri Lanka 2023-09-11

The 1st SLRMES - an ISRM Specialized Conference - will be held in Colombo, Sri Lanka on December 2-7, 2023, organised by the Sri Lankan Rock Mechanics and Engineering Society (SLRMES). 4 Keynotes, 12 Session Lead Lectures, and 66 Regular lectures are expected to be presented on December 4-5, 2023. Three practically oriented short courses and one workshop are listed on the conference website for participants to select and learn on December 2-3, 2023. Two technical tours are listed on the conference website for participants to select and engage on December 6-7, 2023. Possible sightseeing places are listed on the website. Highly affordable accommodation places are listed on the conference website.

The early bird registration deadline is set for September 30th, 2023. In order to take advantage of the highly affordable reduced registration fees, please register through the conference website (www.slrmes.org) as soon as possible and not later than the early bird registration deadline.

Pinnaduwa Kulatilake (kulatila@arizona.edu), Conference Chair

Election of the Regional Vice Presidents for the term of office 2023-2027 2023-09-20

The election of the Regional Vice Presidents of the ISRM for the term of office 2023-2027 will take place during the 2023 ISRM Council meeting, to take place on 10 October, in Salzburg, Austria. The presentation of all candidates is now online.

Click here to access the videos of all candidates.

ASSOCIATION INTERNATIONALE DES TUNNELS ET DE L'ESPACE SOUTERRAIN
AITES
ITA
INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION

Scooped by ITA-AITES #100, 5 September 2023

China's longest expressway shield tunnel drilled

The longest tunnel in Canada Is a 9-mile engineering masterpiece

Project Auckland: Hiwa-i-te-Rangi reaches major milestone | New Zealand

Why is the Gotthard Base Tunnel so important? | Switzerland

How About Living Underground on Mars?

Deepest metro station at Thirumayilai to be operational by 2028 | India

The longest underwater tunnel in the world | Germany-Denmark

Robot dog halves time workers spend in confined spaces

This ancient Roman tunnel in Jordan is believed to be longest of antiquity

Scooped by ITA-AITES #101, 19 September 2023

Melbourne Metro Rail Project | Australia

Signify supports Dublin Port Tunnel with a fast route to energy efficiency | UK

DC Water completes tunnel project aimed alleviating Northeast flood problems | USA

Work on Dwarka expressway tunnel connecting Haryana border to IGI Airport 80% complete | India

Gateway tunnel project: Contracts approved for first phases | USA

Israel's Metro M2 line approved, budget released

HS2: Northamptonshire village sees longest 'green' tunnel emerge | UK

Breakthrough for London's newest underground tunnel | UK

World's Longest Underwater Tunnel Unveiled

Video shows newly inaugurated Yashobhoomi Dwarka Sector 25 metro station | India

BRITISH TUNNELLING SOCIETY

BTS September Lecture: Lessons Learned from the purpose-built Multi Service Vehicle (MSV) Fire at HS2 Chiltern Tunnels

Speakers: Shannon O'Keeffe and Neil Hancox

14 September 2023, [in-person] Institution of Civil Engineers, One Great George Street, Westminster, London

A fire occurred during the construction of the down line Chiltern Tunnel on the 10th of May 2022. At the start of a night shift, a purpose-built MSV for personnel was carrying Tunnel Boring Machine (TBM) shift workers and was being driven into the tunnel when a fire occurred in the engine compartment. The MSV was approximately 2.6 Kilometers in from the entrance when it was stopped.

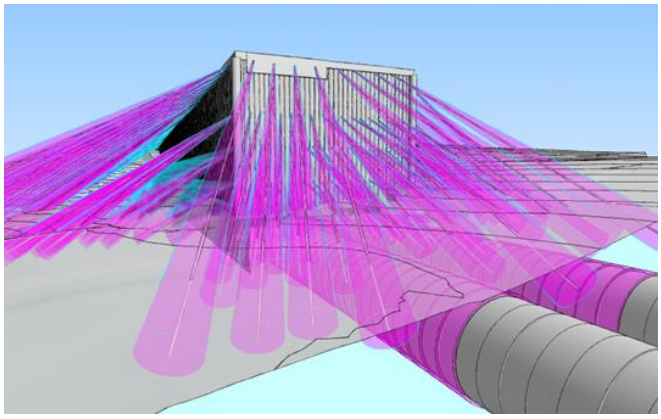
Since the incident, a full review of emergency response and ongoing situation has been conducted with emergency services and other agencies at Strategic, Tactical and Operational levels to ensure all lessons learned have been captured.

This presentation will focus on sharing the lessons learned from the MSV fire with the wider industry.

BTSYM September Lecture: Special excavation design for complex anchor wall design

Speaker: Daniel Hierro Tobar

21 September 2023, [in-person] Institution of Civil Engineers, One Great George Street, Westminster, London

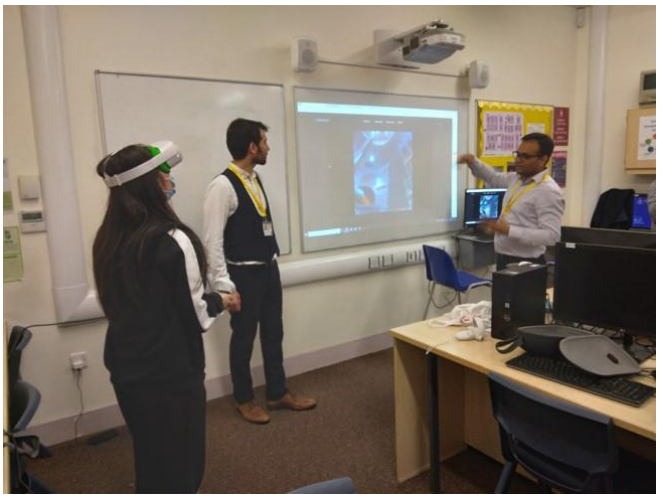


In this Lecture Daniel will showcase the alternative strategies and solutions formulated to address the diverse stages of a wall design under intricate conditions, involving deep competent rock, water presence, asymmetric loads, and potential tunnel interference.

Leveraging 3D BIM and Plaxis models, the project aims to optimize solutions and address real-world conditions accurately. These advanced modelling techniques enable the visualization, analysis, and manipulation of complex structural and geological data, ensuring a highly accurate representation of the site's conditions.

Update on BTSYM Schools and Universities

Speaker: Sandeep Singh Nirmal



Often hidden in the shadows, the BTSYM Schools and Universities sub-committee undertakes essential work to inspire school children into engineering and encourage university students to consider careers in tunnelling. Sandeep will be giving an update on this year's achievements and a look-ahead for next year.

https://www.youtube.com/watch?v=D9dlfJdCjYE

News

IGS 'Diversity Session' Agenda Announced September 6, 2023

Personal stories from members of the IGS family about the experiences and challenges of working in the geosynthetics industry will be shared at the IGS Read More »

Minutes from the IGS General Assembly 20 September 2023

Please find linked below the meeting minutes from the IGS General Assembly held 20 September 2023 in Rome, Italy at the 12th International Conference on Geosynthetics (12 ICG).

GA Minutes 20 Sept 2023 (v2)

Kind Regards,

Elise Oatman
IGS Secretariat Manager
International Geosynthetics Society

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

InFUM - 1st International Symposium on Fiber Shotcrete for Underground Mining, October 1st to 4th, 2023, Rio de Janeiro, Brazil, https://infum.com.br

AFTES 2023 17th International Congress "Underground space at the heart of transitions", 2-4 October 2023, Paris, France, https://aftes2023.com/en

SEG23 Symposium on Energy Geotechnics, 3-5 October 2023, Delft, The Netherlands, https://seg23.dryfta.com

28th European Young Geotechnical Engineers Conference and Geogames
04 – 07 October 2023, Moscow, Russia

Organiser: Russian Society for Soil Mechanics, Geotechnics and Foundation Engineering

Contact person: PhD Ivan Luzin
Address: NR MSUCE, 26 Yaroslavskoye shosse
Phone: +7-495-287-4914 (2384)
Email: youngburo@gmail.com

GROUND ENGINEERING BASEMENTS AND UNDERGROUND STRUCTURES, 5 October 2023, London, U.K., https://basements.geplus.co.uk/basements2023/en/page/home

GROUND ENGINEERING SMART GEOTECHNICS, 5 October 2023, London, U.K., https://smartgeotechnics.geplus.co.uk/smartgeotechnics2023/en/page/home

MSL 2023 The Second Mediterranean Symposium on Landslides "Slope Stability in Stiff Fissured Clays and Soft Rocks", October 5-7, 2023, Hammamet, Tunisia, https://msl-2023.webnode.fr

2023 15th ISRM Congress, International Congress in Rock Mechanics Challenges in Rock Mechanics and Rock Engineering, 9÷14 October 2023, Salzburg, Austria, https://www.isrm2023.info/en/

11th International Symposium on Ground Freezing (ISGF), 13 October 2023, London, United Kingdom, www.iom3.org/events-awards/11th-international-symposium-on-ground-freezing.html

HYDRO 2023 New Ideas for Proven Resources, 16-18 October 2023, Edinburgh, Scotland, www.hydropower-dams.com/hydro-2023

1-ICGTMW2023 1st International Conference on Geotechnics of Tailings and Mine Waste & GEOMIN 2023, 24th to 26th, October 2023, Ouro Preto, Minas Gerais, Brazil, https://geominouropreto.com.br/2023/icgtmw2023

SEAGC-AGSSEA 2023 21st Southeast Asian Geotechnical Conference & 4th AGSSEA Conference, 25th to 27th October 2023, Bangkok Thailand, https://seagcagssea2023.com

Geotechnics for Offshore Wind, 30 October 2023, Tokyo, Japan, https://confit.atlas.jp/guide/event/geotechwind2023/static/program

ACUUS SINGAPORE 2023 18th Conference of the Associated Research Centers for the Urban Underground Space "Underground Space – the Next Frontier", 1 - 4 Nov 2023, Singapore, www.acuus2023.com

ATC 2023 18th Australasian Tunnelling Conference: Trends and Transitions in Tunnelling, 5-8 November, 2023, Auckland, Aotearoa New Zealad https://atc2023.com

6th World Landslide Forum "Landslides Science for sustainaible development", 14 to 17 November 2023, Florence, Italy, https://wlf6.org

4th International Tunnelling and Underground Space Conference- Lagos, 2023, 15-16 November 2023, Lagos, Nigeria, www.tunnellingnigeria.org

CREST 2023 – 2nd Construction Resources for Environmentally Sustainable Technologies, November 20-22, 2023, Fukuoka, Japan, https://www.ic-crest.com

TUNNELLING ASIA 2023 International Conference on Climate Resilience and Sustainability in Tunnelling and Underground Space, 22-23 November 2023, Mumbai, India, https://www.tai.org.in

1st SLRMES Conference on Rock Mechanics for Infrastructure and Geo-Resources Development - an ISRM Specialized Conference, Colombo, Sri Lanka, December 2-7, 2023, www.slrmes.org

GEOTEC HANOI 2023 The 5th International Conference on Geotechnics for Sustainable Infrastructure Development, December 14-15, 2023 - Hanoi, Vietnam, https://geotechn.vn

9th International Symposium on RCC Dams and CMDs December, 2023, Guangzhou, China, www.chincold-smart.com/meetings/rcc2023

ICSGE 16th International Conference on Structural and Geotechnical Engineering, 27 – 28 December 2-23, New Cairo, Egypt, https://eng.asu.edu.eg/icsge

ISGHS 2024 International Symposium on Geotechnical Aspects of Heritage Structures, 14-16 Feb 2024, Tiruchirappalli, India, www.isghs2024.in, www.igstrichy.org

IEMTA Southeast Asian Conference and Exhibition on Tunnelling and Underground Space 2024 (SEACETUS2024), 05 - 07 March 2024, Kuala Lumpur, Malaysia, https://submit.confbay.com/conf/seacetus2024

7th International Conference Series on Geotechnics, Civil Engineering and Structures (CIGOS)

April 4-5, 2024, Ho Chi Minh City, Vietnam

Organiser: Association of Vietnamese Scientists and Experts (AVSE Global) and University of Architecture Ho Chi Minh City (UAH)

Contact Person: cigos2024@sciencesconf.org
Email: cigos2024@sciencesconf.org

World Tunnel Congress 2024 19 to 25, April, 2024, Shenzhen China, www.wtc2024.cn

iCGE'24 International Conference of Geotechnical Engineering, April 25-27, 2024, Hammamet, Tunisia www.icge24.com

GEO AMERICAS 2024 5th Pan-American Conference on Geosynthetics Connecting State of the Art to State of Practice April 28 – May 1, 2024, Toronto, Canada, www.geoamericas2024.org

IFCEE 2024 International Foundation Congress and Equipment Expo, May 7 –10, 2024, Dallas, USA https://web.cvent.com/event/c42dd622-dd91-409f-b249-2738e31c9ef5/summary

8th International Conference on Earthquake Geotechnical Engineering (8ICEGE), 7-10 May, 2024 Osaka, Japan, https://confit.atlas.jp/guide/event/icege8/top?lang=en

GeoShanghai 2024 International Conference on Geotechnical Engineering, May 26 – 29, 2024, Shanghai, China, www.geoshanghai.org

2nd annual Conference on Foundation Decarbonization and Re-use, May 28-30 2024, Amsterdam, The Netherlands, https://foundationreuse.com

IS-Macau 2024 11th International Symposium of Geotechnical Aspects of Underground Construction in Soft Ground, June 14-17, 2024, Macao SAR, China, https://is-macau2024.skliotsc.um.edu.mo

ISC'7 7th International Conference on Geotechnical and Geophysical Site Characterization "Ground models, from big data to engineering judgement", June 18-21, 2024, Barcelona, Spain, https://isc7.cimne.com

28th European Young Geotechnical Engineers, Conference 2024

25 to 29 June 2024, Skopje, North Macedonia

Contact person: Ms. Elena Angelova
Address: Blvd. Partizanski odredi No.24,
Email: mag@gf.ukim.edu.mk
Website: https://mag.net.mk

WCEE2024 18th World Conference on Earthquake Engineering, June 30 - July 5, 2024, Milan, Italy, www.wcee2024.it

WCEE2024 18th World Conference on Earthquake Engineering, June 30 - July 5, 2024, Milan, Italy, www.wcee2024.it / Session SHR-7: When science meets industry: advances in engineering seismology stemming from engineering practice, olga.ktenidou@gmail.com

3rd ICPE 2024 Third International Conference on Press-in Engineering, 3-5 July 2023, Singapore, https://2024.icpe-ipa.org

ICEC2024
SECOND INTERNATIONAL CONFERENCE ON EARTHEN CONSTRUCTION
EDINBURGH

8-10 July 2024, Edinburgh, United Kingdom
https://icec2024.eng.ed.ac.uk, https://icec2024.sciencesconf.org

On behalf of the steering and organising committees, welcome to ICEC2024, the Second RILEM International Conference on Earthen Construction

The First RILEM International Conference on Earthen Construction (ICEC 2022), hosted by the Université Gustave Eiffel in March 2022, demonstrated the depth and volume of research applicable to and supporting the use of earth as a construction material. Approximately two hundred researchers, academics, and engineers attended that event to share their knowledge and to learn from like-minded professionals engaged in objective, scientific research into the performance and real construction potential of these materials.

The Second RILEM ICEC will build upon that success to provide a forum to present work on a wide range of topics related to earthen construction. The conference aims to grow and broaden the global network of earthen construction researchers, to attract new members to the RILEM technical committees on earth, and to identify opportunities for future research.

Topics

- Material characterisation and quality control
- Hydro-mechanical behaviour
- Reinforcement behaviour
- Seismic behaviour

- In situ and field testing
- Additive manufacturing (3D printing)
- Rheology
- Biostabilisation
- Molecular simulation
- Physical chemistry
- Microstructure
- Durability
- Fire performance
- Hygro-thermal behaviour
- Air quality
- Life cycle analysis
- Climate change adaptation
- Economic impacts
- Cultural history
- Earthen architecture

Contact Us

ICEC2024 webpages

Conference information and registration: https://icec2024.eng.ed.ac.uk/

Conference information and abstract/paper submission: https://icec2024.sciencesconf.org/

Contact

General enquiries: ICEC2024@ed.ac.uk

IS Landslides 2024 International Symposium on Landslides "Landslides across the scales: from the fundamentals to engineering applications" & IS Rock Slope Stability 2024, July 7-12th, 2024, Chambéry, France, www.isl2024.com

EUROCK 2024 ISRM European Rock Mechanics Symposium New challenges in rock mechanics and rock engineering July 15-19, 2024, Alicante, Spain, www.eurock2024.com

ECSMGE 24 XVIII European Conference on Soil Mechanics and Geotechnical Engineering, 26-30 August 2024, Lisbon, Portugal, www.ecsmge-2024.com

ISIC 2024 4th International Conference of International Society for Intelligent Construction, 10 – 12 September 2024, Orlando, United States, www.is-ic.org/conferences/2024-isic-international-conference

NGM 2024 19th Nordic Geotechnical Meeting, 18th - 20th of September 2024, Göteborg, Sweden, www.ngm2024.se

ISRM International Symposium 2024 and 13th Asian Rock Mechanics Symposium (ARMS13), 22 to 27 September 2024, New Delhi, India, https://arms2024.org

IS-Grenoble 2024 Geomechanics from Micro to Macro, September 23-27, 2024, Grenoble, France, https://is-grenoble2024.sciencesconf.org

5th European Conference on Physical Modelling In Geotechnics

02 to 04 October 2024, Delft, Netherlands

Organiser: Deltares & Delft University of Technology

Contact person: Suzanne van Eekelen & Miguel Cabrera

Email: organisation.ecpmg24@gmail.com

XVIII African Regional Conference on Soil Mechanics and Geotechnical Engineering, 06 ÷ 09 October 2024, Algiers, Algeria, https://algeos-dz.com/18ARC.html

RMCC2023 1st International Rock Mass Classification Conference "Rock Mass Classification meets the Challenges of the 21st Century", 30-31 October 2024, Oslo, Norway, www.rmcc2024.com

PANAMGEO CHILE 2024 17th Pan-American Conference on Soil Mechanics and Geotechnical Engineering, 12-17 November 2024, La Serena, Chile, https://panamge-ochile2024.cl

CouFrac2024

The 4th International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling and Application - an ISRM Specialized Conference

13 – 15 September 2024, Kyoto, Japan

Organizer: Kyoto University
Contact Person Name: Prof. Hideaky Yasuhara
Email: yasuhara.hideaki7p@kyotot-u.ac.jp
Telephone: +81753833306

ICTG 2024 5th International Conference on Transportation Geotechnics 2024 "Sustainable and Evolving Technologies for Urban Transport Infrastructure", 20 – 22 November 2024, Sydney, Australia www.ictg2024.com.au

World Tunnel Congress 2025 "Tunnelling into a sustainable future – methods and technologies", 9-15 May 2025, Stockholm, Sweden, www.wtc2025.se

Eurock 2025
ISRM European Rock Mechanics Symposium
Expanding the underground space - future development of the subsurface - an ISRM Regional Symposium
16 – 20 June 2025, Trondheim, Norway

Contact Person Name: Henki Ødegaard
Email: henki.oedegaard@multiconsult.no
Telephone: +47 22 94 75 00
Address: C/O Fredrik Stray, TEKNA, PO box 2312 Solli, Oslo, Norway

21st International Conference on Soil Mechanics and Geotechnical Engineering
14 – 19 June 2026, Vienna, Austria

Organisers: Austrian Geotechnical Society and Austrian Society for Geomechanics
Contact person: Prof. Helmut F. Schweiger
Email: helmut.schweiger@tugraz.at

16th International Congress on Rock Mechanics
Rock Mechanics and Rock Engineering Across the Borders
17-23 October 2027, Seoul, Korea

Scope

The scope of the Congress will cover both conventional and emerging topics in broadly-defined rock mechanics and rock engineering. The themes of the Congress include but not be limited to the following areas:

- Fundamental rock mechanics
- Laboratory and field testing and physical modeling of rock mass
- Analytical and numerical methods in rock mechanics and rock engineering
- Underground excavations in civil and mining engineering
- Slope stability for rock engineering
- Rock mechanics for environmental impact
- Sustainable development for energy and mineral resources
- Petroleum geomechanics
- Rock dynamics
- Coupled processes in rock mass
- Underground storage for petroleum, gas, CO2 and radioactive waste
- Rock mechanics for renewable energy resources
- Geomechanics for sustainable development of energy and mineral resources
- New frontiers & innovations of rock mechanics
- Artificial Intelligence, IoT, Big data and Mobile (AICBM) applications in rock mechanics
- Smart Mining and Digital Oil field for rock mechanics
- Rock Engineering as an appropriate technology
- Geomechanics and Rock Engineering for Official Development Assistance (ODA) program
- Rock mechanics as an interdisciplinary science and engineering
- Future of rock mechanics and geomechanics

Our motto for the congress is "Rock Mechanics and Rock Engineering Across the Borders". This logo embodies the interdisciplinary nature of rock mechanics and challenges of ISRM across all countries and generations.

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Video shows the moment apartment building sinks by one floor in Taipei

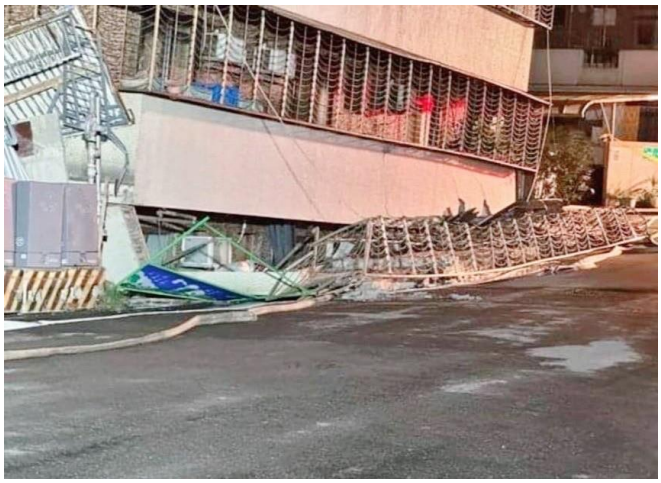


Image of the building after sinking (credits: Wang Hong-wei Facebook)

Footage has emerged showing an apartment building in Taipei, Taiwan, sinking by one floor into the ground on the evening of Thursday, September 7.

Furthermore, reports were made to the Taipei City Government offices on Thursday evening about tilting occurring on residential buildings in Taipei's Dazhi area, of Zhongshan District.

More specifically, according to Taipei News, there were five to six buildings in the area presenting cracks and tilting, while complaints had previously been made about the issue.

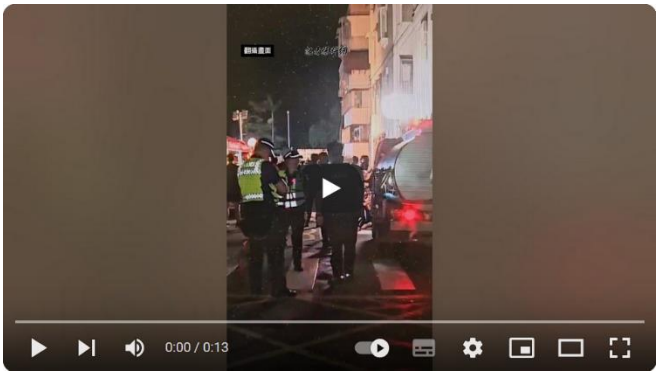
The reason behind the event was reported to be an excavation taking place on a nearby construction site, which at the time had reached a depth of three floors, but proper foundation work had not been completed.

This resulted in the excavation's slurry wall failing, making it unable to provide adequate support to the surrounding soil mass.

At 10.49 p.m. on Thursday, one of the nearby buildings was caught on video sinking into the ground and tilting. Shortly after, at about 11 p.m., the Mayor of Taipai, Chiang Wan-an, arrived on scene.

Attempting to mitigate, crews were mobilized to inject water and grout into the ground to restore supporting pressure to the tilted building and reduce any further movement.

Nearby residents were evacuated, with reports stating that the initial number of evacuees was 144 people from 35 households, which was later raised to 367 residents from 197 households being accommodated in hotels, while nobody got hurt in the events.



https://www.youtube.com/watch?v=vDhAKSM9XHU

Sources: www.taiwannews.com.tw, www.taiwan-news.com.tw

(Geoengineer.org, Sep, 07, 2023, https://www.geoengineer.org/news/video-shows-the-moment-apartment-building-sinks-by-one-floor-in-taipei)

103 new geotechnical engineering software added to DCOdes

103 new software regarding geotechnical engineering, many of which are available for free, have been added to DCOdes.

They include solutions for mining, data management, site and laboratory investigation, shallow and deep foundation design, geotechnical earthquake engineering and more.

You can explore the full geotechnical engineering software and script list here.

(Geoengineer.org, Sep, 22, 2023, https://www.geoengineer.org/news/103-new-geotechnical-engineering-software-added-to-dcodes)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ & ΑΝΤΙΣΕΙΣΜΙΚΗ ΜΗΧΑΝΙΚΗ

Deep learning model boosts earthquake analysis

Seismologists in California and Germany have developed a deep learning model for forecasting earthquake aftershocks that can outperform existing data analysis methods

Damage from a 2020 earthquake in Puerto Rico - *United States Geological Survey*

Known as RECAST (Recurrent Earthquake forecast), the programme was created by researchers at the University of California, Santa Cruz and Technical University of Munich. It's claimed that RECAST outperformed the current model, known as the Epidemic Type Aftershock Sequence (ETAS) model, for earthquake catalogues of about 10,000 events and greater. The work is published in *Geographical Physical Letters*.

"The ETAS model approach was designed for the observations that we had in the 80s and 90s when we were trying to build reliable forecasts based on very few observations," said lead author Kelian Dascher-Cousineau, who recently completed his PhD at UC Santa Cruz. "It's a very different landscape today."

Due to the proliferation of more sensitive seismological equipment and an increase in data storage capabilities, earthquake catalogues have become larger and more detailed. According to study co-author Emily Brodsky, the traditional ETAS model was not built to handle these larger data sets.

"We've started to have million-earthquake catalogues, and the old model simply couldn't handle that amount of data," said Brodsky, a professor of earth and planetary sciences at UC Santa Cruz.

In order to demonstrate the capabilities of the RECAST model, the group first used an ETAS model to simulate an earthquake catalogue. After working with the synthetic data, the researchers tested the RECAST model using real earthquake data from Southern California. They found that RECAST performed slightly better than ETAS at forecasting aftershocks, particularly as the amount of data increased. The computational effort and time were also significantly better for larger catalogues.

The team believes the model's flexibility could also open up new possibilities for earthquake forecasting. With the ability to adapt to large amounts of new data, models that use deep learning could potentially incorporate information from multiple regions at once to make better forecasts about poorly studied areas.

"We might be able to train on New Zealand, Japan, California and have a model that's actually quite good for forecasting somewhere where the data might not be as abundant," said Dascher-Cousineau.

(THE ENGINEER, 04 Sep 2023, https://www.theengineer.co.uk/content/news/deep-learning-model-boosts-earthquake-analysis)

Using Deep Learning for Flexible and Scalable Earthquake Forecasting

Kelian Dascher-Cousineau, Oleksandr Shchur, Emily E. Brodsky, Stephan Günnemann

Abstract

Seismology is witnessing explosive growth in the diversity and scale of earthquake catalogs. A key motivation for this community effort is that more data should translate into better earthquake forecasts. Such improvements are yet to be seen. Here, we introduce the Recurrent Earthquake foreCAST (RECAST), a deep-learning model based on recent developments in neural temporal point processes. The model enables access to a greater volume and diversity of earthquake observations, overcoming the theoretical and computational limitations of traditional approaches. We benchmark against a temporal Epidemic Type Aftershock Sequence model. Tests on synthetic data suggest that with a modest-sized data set, RECAST accurately models earthquake-like point processes directly from cataloged data. Tests on earthquake catalogs in Southern California indicate improved fit and forecast accuracy compared to our benchmark when the training set is sufficiently long ($>10^4$ events). The basic components in RECAST add flexibility and scalability for earthquake forecasting without sacrificing performance.

Key Points

- We introduce a deep learning model for earthquake forecasting and explore its performance on synthetic and regional earthquake data sets
- It is flexible in the sense that a predefined functional form is not required
- It is scalable in two senses: it is efficient on large data sets, and its performance relative to benchmarks improves with more training data

Plain Language Summary

We explore the potential for deep learning in earthquake forecasting. Prior work has relied heavily on statistical models that do not scale to fully utilize the currently available large earthquake data sets. Here we build on recent developments in deep learning for forecasting event sequences in general to create an implementation for earthquake data. The new approach allows us to incorporate larger data sets, potentially with more information about each earthquake. We also avoid a specific functional form, so the method naturally adapts to additional information about events, like magnitude or varia-

tions in behavior over time. As we add more data, results show continued improvements. This ability to incorporate and improve continually as training data sets increase indicates that there is more information in the earthquake catalogs than has yet been used for earthquake forecasting.

(Geophysical Research Letters, First published: 31 August 2023, https://doi.org/10.1029/2023GL103909, https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023GL103909)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΔΙΑΦΟΡΑ

15 places on Earth that look like alien planets

While we often look to the stars, planets and moons for bizarre and fantastic sites, the Earth itself remains home to vast and varied landscapes and structures, fit for a science-fiction epic. Here are 15 of our favorites.

1. Fly Geyser, Nevada

Aerial shot of Fly Geyser up close. (Image credit: Steve Tietze via Getty Images)

This man-made geothermal geyser was created by accident. After the area had been drilled for water and resealed multiple times, Fly Geyser grew from mineral deposits. These deposits along with thermophilic algae create its fantastic red and green hues.

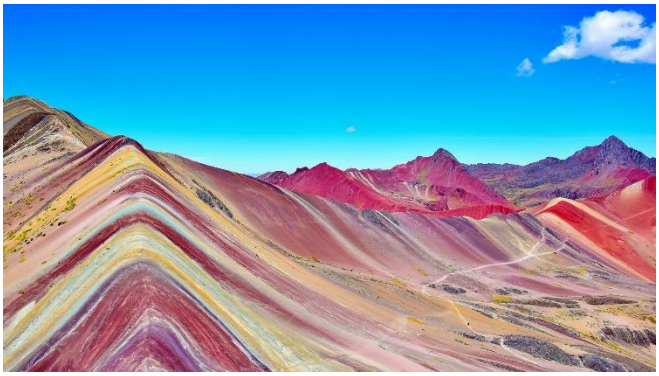
2. Grand Prismatic Spring, Yellowstone

Grand Prismatic Spring, Midway Geyser, Yellowstone. (Image credit: Ignacio Palacios via Getty Images)

Yellowstone's largest hot spring measures 200-330 feet (60 to 90 meters) in diameter and over 121 feet (36 m) in depth, according to the National Park Service. Its wild rainbow pattern is created by thermophilic algae and bacteria along a temperature gradation, with the hottest water — which is actually sterile and the cause of the vibrant blue shade — at the center of the spring.

3. Rainbow Mountain, Peru

Also known as Vinicunca, or the Mountain of Seven Colors, Rainbow Mountain was discovered in 2015 after its usual snow covering melted. Its colorful stripes of rose, gold, mint, and lavender are created from the mountain's mineral makeup and weathering over time.



Rainbow Mountain in the Cusco region of Peru. (Image credit: Wirestock / Getty Images)

Also known as Vinicunca, or the Mountain of Seven Colors, Rainbow Mountain was discovered in 2015 after its usual snow covering melted. Its colorful stripes of rose, gold, mint, and lavender are created from the mountain's mineral makeup and weathering over time.

4. Danakil Depression, Ethiopia

Hot springs in the Danakil Depression. (Image credit: Wysiati via Getty Images)

Danakil Depression is the result of the divergence of three tectonic plates beneath northern Ethiopia. Sulfur springs, volcanoes, geysers, lakes, and pools cover this spooky desert formation where temperatures reach over 122 degrees Fahrenheit (50 Celsius).

5. Lake Hillier, Australia

Lakie Hillier in Australia (Image credit: Getty Philip Thurston via Getty Images)

Australia's Barbie-pink Lake Hillier gets its candy-colored hue from algae, halobacteria, and microbes and has a salinity equal to that of the Dead Sea.

6. Cave of Crystals, Naica, Mexico

The Cave of Crystals in Naica, Mexico. (Image credit: Javier Trueba)

Massive crystal pillars of gypsum fill the hot, humid cavern of the Cave of Crystals. Its crystals are hundreds of thousands of years old and continue to actively grow.

7. Princess Elisabeth polar research station, Antarctica

Princess Elisabeth polar research station, Antarctica. (Image credit: René Robert - International Polar Foundation)

Princess Elisabeth station in Antarctica is the first zero-emission polar research station. According to the International Polar Foundation, the center "integrates passive building technologies, renewable wind and solar energy, and water treatment facilities," and is dedicated to maximizing energy efficiency.

8. Habitat 67, Montreal, Canada

Habitat 67 buildings on St. Helene island in Montreal, Canada. (Image credit: Megapress / Alamy Stock Photo)

With a mission to "reinvent the apartment building," architect Moshe Safdie created Habitat 67 in 1967 in Cité-du-Havre, an artificial peninsula in Montreal. The modular structure was meant to reinvent urban living and stands today as a unique architectural feet.

9. The Eden Project, Cornwall, England, UK

Biomes at the Eden Project in Cornwall, England, UK. (Image credit: Andrew Holt / Getty Images)

The Eden Project is an experimental garden, greenhouse, and sustainability center with a mission that focuses on "environmental harmony and social equity," located in Cornwall, England.

10. Underwater waterfall, Mauritius Island

Mauritius island, including the famous Le Morne Brabant mountain, the beautiful blue lagoon, and underwater waterfall. (Image credit: Myroslava Bozhko / Alamy Stock Photo)

The island of Mauritius, east of Madagascar in the Indian Ocean, is home to an "underwater waterfall" beneath its blue lagoon. The waterfall is actually an optical illusion caused by the drastic drop of the continental shelf.

11. Gardens by the Bay, Singapore

Gardens by the Bay in Singapore. (Image credit: Tuul & Bruno Morandi via Getty Images)

Singapore's Gardens by the Bay is a "showpiece of horticulture and garden artistry," that opened to the public in October, 2011. It is founded on sustainability, international horticulture, and a goal to showcase "a city in a garden."

12. Salar de Uyuni, Bolivia

Salar de Uyuni in Bolivia. (Image credit: Ignacio Palacios via Getty Images)

The eerie, yet beautiful, landscape of Bolivia's Salar de Uyun is a center for salt and lithium harvesting, as well as a tourist destination.

13. Socotra, Yemen (dragon's blood trees)

Dragon's blood trees in Socotra, Yemen. (Image credit: John M Lund Photography Inc via Getty Images)

The bizarre dragon's blood tree, with its vein-like umbrella canopy, is only native to the remote island of Socotra, located two hundred miles off Yemen.

14. The Wave, Coyote Buttes, Arizona

The Wave, Coyote Buttes, Arizona (Image credit: Praveen P.N via Getty Images)

The winding, striped sandstone rock formation known as The Wave is part of the Coyote Buttes on the Arizona-Utah border in the U.S.

15. Svalbard Global Seed Vault, Norway

Entryway to the Global seed vault in Svalbard, Norway. (Image credit: BDphoto via Getty Images)

According to Crop Trust, the Global Seed Vault in Svalbard, Norway is "the ultimate insurance policy for the world's food supply," as it has the capacity to store 4.5 million crop varieties and up to 2.5 billion seeds. The vault is ready to withstand "doomsday" circumstances.

(Annie Corinne Shaink / LIVESCIENCE, 22.09.2023, https://www.livescience.com/planet-earth/places-on-earth-that-look-like-alien-planets)

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ

Ασκήσεις στη Μηχανική των Πετρωμάτων

Συνοπτική θεωρία • Λυμένες ασκήσεις και εφαρμογές

Αγιουτάντης Ζαχαρίας, Κακλής Κωνσταντίνος

Το βιβλίο αυτό γράφτηκε με σκοπό να αποτελέσει βοήθημα για τους φοιτητές των τμημάτων Πολιτικών Μηχανικών, Μηχανικών Ορυκτών Πόρων, Μηχανικών Μεταλλείων – Μεταλλουργών, Γεωλογίας και Γεωπεριβάλλοντος των Ανωτάτων Εκπαιδευτικών Ιδρυμάτων της χώρας μας. Κάποια από τα διδασκόμενα μαθήματα που έχουν άμεση σχέση με το παρόν σύγγραμμα είναι: "Μηχανική Πετρωμάτων", "Σήραγγες και Υπόγεια Έργα", "Υποστήριξη Υπογείων έργων", "Τεχνική Γεωλογία", "Βραχομηχανική – Σήραγγες", "Στοιχεία Γεωτεχνικής Μηχανικής", "Προχωρημένη Γεωμηχανική", "Γεωλογία Τεχνικών Έργων και Βραχομηχανική", και "Πειραματική Βραχομηχανική".

Το θεωρητικό υπόβαθρο της Μηχανικής των Πετρωμάτων παρουσιάζεται εκτενώς στα αντίστοιχα ελληνόγλωσσα βιβλία τα οποία καλύπτουν το γνωστικό αυτό αντικείμενο. Το παρόν σύγγραμμα επικεντρώνεται στην ανάλυση και επεξήγηση της επίλυσης απλών και σύνθετων ασκήσεων Μηχανικής Πετρωμάτων. Με στόχο τη διευκόλυνση του αναγνώστη, στην αρχή του κάθε κεφαλαίου γίνεται μια περιληπτική παρουσίαση της σχετικής θεωρίας η οποία είναι η απολύτως απαραίτητη για την επίλυση των αντίστοιχων ασκήσεων. Δίνεται ιδιαίτερη προσοχή στις εξισώσεις που ορίζουν τα διάφορα μεγέθη καθώς και στις σχέσεις μεταξύ τους και παράλληλα παρουσιάζεται η μεθοδολογία εργασίας που συνήθως ακολουθείται για την επίλυση των ασκήσεων αυτών. Επιπλέον εξηγείται με όσο το δυνατόν μεγαλύτερη λεπτομέρεια το κάθε βήμα με συνεχή αναφορά στις αντίστοιχες εξισώσεις και σχέσεις.

Η ύλη (μετά την *Εισαγωγή – Κεφάλαιο 1*) κατανέμεται στα παρακάτω κεφάλαια:

Στο δεύτερο (2ο) κεφάλαιο παρατίθενται το μαθηματικό υπόβαθρο και τα βασικά στοιχεία της θεωρίας των διανυσμάτων και των τανυστών που χρησιμοποιούνται κατά κόρον στην ανάλυση της θεωρίας και στις θεωρητικές εφαρμογές των επόμενων κεφαλαίων.

Το τρίτο (3ο) κεφάλαιο αναφέρεται στον τανυστή τάσης που χαρακτηρίζει την εντατική κατάσταση σε οποιοδήποτε σημείο ενός σώματος, ενώ στο τέταρτο (4ο) κεφάλαιο μελετάται η εντατική κατάσταση σε δύο διαστάσεις και δίνεται ιδιαίτερο βάρος στην κατανόηση και στον τρόπο που χρησιμοποιείται ο κύκλος του Mohr. Στο πέμπτο (5ο) κεφάλαιο παρουσιάζεται το μέγεθος της τροπής ή αλλιώς ανηγμένης παραμόρφωσης που συνδέεται άμεσα με τις τάσεις με σχέση αιτίου – αποτελέσματος.

Στο έκτο (6ο) κεφάλαιο περιγράφεται η καταστατική εξίσωση ελαστικής συμπεριφοράς σε δύο και τρεις διαστάσεις. Το ελαστικό μοντέλο αντιπροσωπεύει την πιο κοινή καταστατική συμπεριφορά των υλικών μηχανικής, συμπεριλαμβανομένων πολλών πετρωμάτων, και αποτελεί μια χρήσιμη βάση για την περιγραφή πιο περίπλοκης συμπεριφοράς. Η ελαστική συμπεριφορά ενός σώματος κάτω από συγκεκριμένη εντατική κατάπόνηση αναλύεται εφαρμόζοντας τον νόμο του Hooke για τρεις διαστάσεις.

Τα κριτήρια αστοχίας, που αποτελούν μαθηματικές εκφράσεις και έχουν την ικανότητα να εκτιμούν πότε θα συμβεί η αστοχία του πετρώματος, μελετώνται στο έβδομο (7ο) κεφάλαιο. Παρουσιάζεται ο τρόπος εφαρμογής δύο βασικών και ευρέως εφαρμόσιμων κριτηρίων αστοχίας στην περίπτωση του άρρηκτου πετρώματος και της βραχομάζας.

Στο όγδοο (8ο) κεφάλαιο εξετάζεται η ευστάθεια κυκλικών και ελλειπτικών υπόγειων ανοιγμάτων (σηράγγων και φρεάτων), η ζώνη επιρροής αυτών, καθώς και η ευστάθεια υπόγειων ανοιγμάτων της μορφής θαλάμων και στύλων.

Αφού γίνει κατανοητή στο ένατο (9ο) κεφάλαιο η ανάλυση και η στερεογραφική προβολή των ασυνεχειών οι οποίες καθιστούν τη μάζα των πετρωμάτων ασυνεχή, το δέκατο (10ο) κεφάλαιο παρουσιάζει τον τρόπο εφαρμογής των σύγχρονων συστημάτων ταξινόμησης της βραχομάζας τα οποία στην ουσία αποδίδουν τιμές σε εκείνες τις ιδιότητες ή χαρακτηριστικά της που θεωρείται πιθανό να επηρεάσουν τη συμπεριφορά της.

Τέλος, στο ενδέκατο (11ο) κεφάλαιο παρουσιάζονται τρόποι εφαρμογής υποστήριξης και ενίσχυσης της βραχομάζας κοντά στα όρια των υπογείων ανοιγμάτων.

(Εκδόσεις ΖΗΤΗ, 2023)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

https://isrm.net/newsletter/show/244

Κυκλοφόρησε το ISRM Newsletter No. 63 - September 2023 με τα ακόλουθα περιεχόμενα:

- Message from the President
- 15th International ISRM Congress, Salzburg, Austria
- 43rd ISRM Online Lecture by Prof. Ana Maria Ferrero
- ISRM International Symposium 2024 and ARMS13, 22-27 September 2024, New Delhi
- Eurock2024, Alicante, Spain, 15-19 July 2024
- Online Course of Slope Engineering by Professor Wu Shunchuan on the ISRM website
- Election of the ISRM Regional Vice Presidents 2023/2027
- 1st Chilean Congress on Rock Mechanics, Santiago, Chile, 22-24 November 2023
- 1st SLRMES Conference on Rock Mechanics for Infrastructure and Geo-resources Development, Colombo, Sri Lanka, 2-7 December 2023
- Activities of the Vice President for Latin America
- ISRM Rocha Medal 2025 nominations by 31 December
- ISRM Sponsored Conferences

ITACET Foundation
Foundation for Education and Training on Tunnelling and Underground Space Use
Newsletter #76
September 2023

www.itacet.org/newsletter37-september-2023

Κυκλοφόρησε το τεύχος 37 Σεπτεμβρίου 2023 του Newsletter του ITACET Foundation με τα ακόλουθα περιεχόμενα:

- Editorial
- Training session reports

  LUNCHTIME LECTURE SERIES #23 Date: 14/02/2023 Location: Online. This instalment of the Lunchtime Lecture series focused on "From procurement to execution of a contract, 3 spotlights". https://www.itacet.org/session/lunchtime-lecture-series-23

PLANNING, CONSTRUCTION AND OPERATION OF COMMON UTILITY CORRIDORSS Date: 13/03/2023 to 15/03/2023 Location: Online. The ITACET Foundation organized an online training session in collaboration with the ITACET Committee and Mutlaq Al Ghowairi for Contracting LTD in Saudi Arabia... https://www.itacet.org/session/planning-construction-and-operation-common-utility-corridors-0

LUNCHTIME LECTURE SERIES #24 Date: 14/03/2023 Location: Online. This instalment of the Lunchtime Lecture series focused on "Risk Management". https://www.itacet.org/session/lunchtime-lecture-series-24

LUNCHTIME LECTURE SERIES #25 Date: 11/04/2023 Location: Online. This instalment of the Lunchtime Lecture series focused on 'Service of machinery in mechanized tunnelling'. https://www.itacet.org/session/lunchtime-lecture-series-25

RISK MANAGEMENT AND SUSTAINABLE UNDERGROUND SOLUTIONS Date: 12/05/2023 to 13/05/2023 Location: Athens. A two-day training session on 'Risk management and sustainable underground solutions' was held on 12th & 13th May 2023 in Athens... https://www.itacet.org/session/risk-management-and-sustainable-underground-solutions

LUNCHTIME LECTURE SERIES#26 Date: 13/06/2023 Location: Online. This instalment of the Lunchtime Lecture series focused on 'Life cycle engineering and management of tunnels' https://www.itacet.org/session/lunchtime-lecture-series26

LUNCHTIME LECTURE SERIES #27 Date: 11/07/2023 Location: Online. This instalment of the Lunchtime Lecture series focused on 'Occupational health in tunnelling' https://www.itacet.org/session/lunchtime-lecture-series-27

LUNCHTIME LECTURE SERIES#28 Date: 12/09/2023 Location: Online. This instalment of the Lunchtime Lecture series focused on 'Planning for the subsurface and underground space use'... https://www.itacet.org/session/lunchtime-lecture-series28

Thank you to all those lecturers who presented on behalf of ITACET

Online Lunchtime Lecture series - #23 Pravin Karki, Gonçalo Diniz Vieira, Matthias Neuenschwander

Online Training Session – Planning, construction and operation of common utility corridors Ray Sterling, Pierre-Yves & Michel Gerard, Daniel Svec, Charles Edouard Delpierre, Yan Lee

Online Lunchtime Lecture series - #24 Philip Sanders, Emmanuel Humbert

Online Lunchtime Lecture series - #25 Marco Della Casa, Doug Harding, Jens Classen

Onsite Training Session WTC2023 – Risk management and sustainable underground solutions Chrysothemis Paraskevopoulou, Robert Galler, Mark Diederichs, Gerard Seingre, Sotirios Vardakos, Klaus Rabensteiner, Matthias Neuenschwander, Karin Bäppler, Arnold Dix, Antonia Cornaro, Giovanny Alvarado, Panagiotis (Panos) Spyridis, Mike Mooney, Max Labecki, Konstantinos Kirytopoulos, Wolfgang Aldrian, Andreas Benardos, Sergios Lampropoulos, Ioannis Lefas, Nick Koronakis, Ilias Michalis

Online Lunchtime Lecture series - #26 Konrad Bergmeister, Farid Achha, Panagiotis Spyridis

Online Lunchtime Lecture series - #27 Donald Lamont, Eric Ball

Online Lunchtime Lecture series - #28 Han Admiraal, Antonia Cornaro, Abidemi Agwor

- Forthcoming sessions

  TUNNEL BORING MACHINES AND THEIR USE Date: Sunday, 1 October, 2023 Location: Paris. At the occasion of the AFTES 2023 congress, a training session on 'Tunnel boring machines and their use' will be held on 1st October 2023. https://www.itacet.org/sessions/forthcoming

  RISK MANAGEMENT IN TUNNELLING Date: 11/10/2023, 2023 Location: Online The ITACET Foundation and the Argentinian Association of Tunnels and Underground Space (AATES) organize the online training session during the annual congress on 'Risk management in tunnelling' on October 27th. https://www.itacet.org/session/risk-management-tunnelling-2

  LUNCHTIME LECTURE SERIES#29 Date: 10/10/2023, 2023 Location: Online This instalment of the Lunchtime Lecture series will focus on 'TBM driving main parameters' and is organised in coordination with ITA WG14. It will begin at 13:00 CET time. The episode will feature three lectures and will finish with a Q&A with all speakers. https://www.itacet.org/session/lunchtime-lecture-series29

- Other events in preparation

  The following training programmes are under preparation:

  China, WTC 2024 in Shenzhen Next year's course organized within the scope of the WTC 2024 will be held on 19th and 20th April in Shenzhen. Don't miss this great opportunity to meet with some of the most respected experts within their field and to network with other young professionals. The registration link will be available on the ITACET website shortly.

  Mexico, AMITOS The course will focus on 'Calculation methods for tunnel design'. The date is to be confirmed.

- Other news

  ITACET AWARDS 2023

  The ITACET Foundation recognizes and honours the excellence and dedication of its partners, lecturers & donors. During this year's World Tunnelling Congress in Athens, the Foundation acknowledged the collaboration of Dr Donald Lamont and the Argentina Association of Tunnels and Underground Space (AATES). The Awards were presented by the ITACET President Michel Deffayet during the opening ceremony and ITA's General Assembly.

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2019 – 2023)

Πρόεδρος	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Α' Αντιπρόεδρος	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr
Β' Αντιπρόεδρος	:	Μιχάλης ΠΑΧΑΚΗΣ, Πολιτικός Μηχανικός mpax46@otenet.gr
Γενικός Γραμματέας	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής ΤΕΙ Αθήνας gbelokas@teiath.gr, gbelokas@gmail.com
Ταμίας	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr
Έφορος	:	Γεώργιος ΓΚΑΖΕΤΑΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής Ε.Μ.Π. gazetas@central.ntua.gr, gazetas50@gmail.com
Μέλη	:	Ανδρέας ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής ΕΜΠ aanagn@central.ntua.gr
		Παναγιώτης ΒΕΤΤΑΣ, Πολιτικός Μηχανικός, ΟΜΙΛΟΣ ΤΕΧΝΙΚΩΝ ΜΕΛΕΤΩΝ Α.Ε. otmate@otenet.gr
		Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Ε.Μ.Π. mpanta@central.ntua.gr
Αναπληρωματικά Μέλη	:	Χρήστος ΣΤΡΑΤΑΚΟΣ, Πολιτικός Μηχανικός, ΝΑΜΑ Α.Ε. stratakos@namalab.gr
		Βάλια ΞΕΝΑΚΗ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. vxenaki@edafomichaniki.gr
Εκδότης	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr

ΕΕΕΕΓΜ

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

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

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

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