INTERNATIONAL SYMPOSIUM
PRESERVATION OF MONUMENTS & HISTORIC SITES
SEPTEMBER 2026 | ATHENS, GREECE
ATHENS TC301

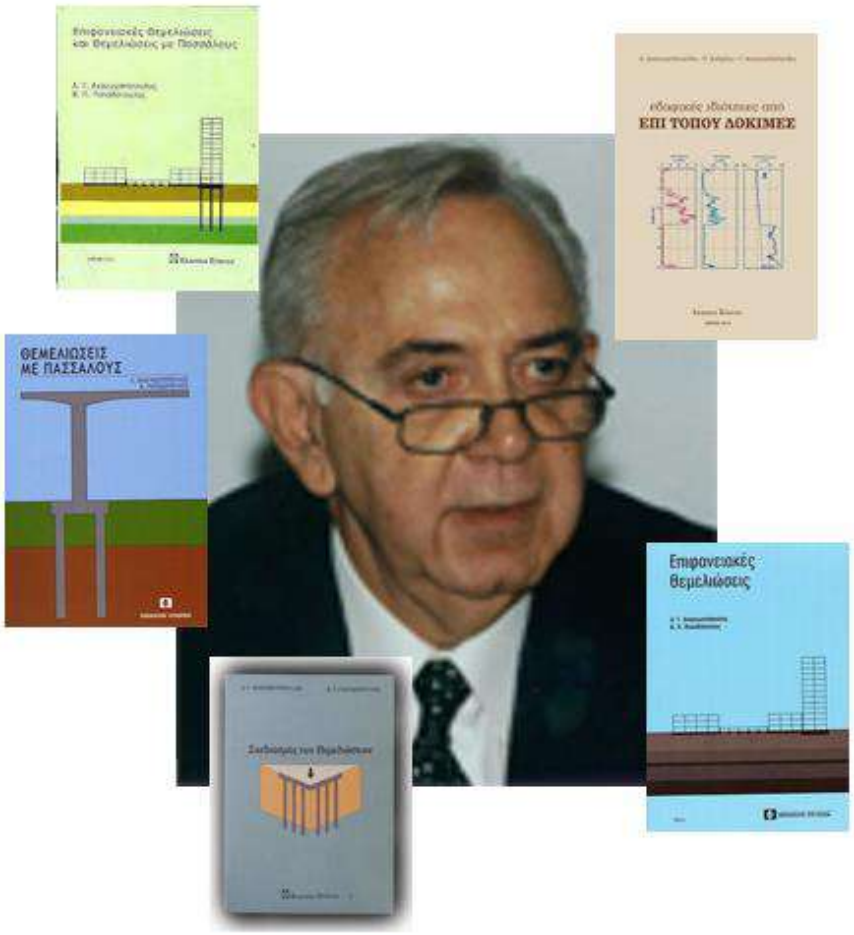
ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

198

Αρ. 198 – ΑΠΡΙΛΙΟΣ 2025

Ανδρέας Αναγνωστόπουλος (1937 – 2025)



Γενικός Γραμματέας ΕΕΕΕΓΜ 1979 – 2008

ISSN: 2732-7248

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

ΑΝΔΡΕΑΣ ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ (1937 – 2025)

Ο Ανδρέας Αναγνωστόπουλος γεννήθηκε στην Αθήνα στις 30 Νοεμβρίου 1937. Αποφοίτησε από την Σχολή Πολιτικών Μηχανικών ΕΜΠ το 1961, όπου επέστρεψε το 1964 ως βοηθός. Το 1968 υποστήριξε διδακτορική διατριβή, που εκπόνησε υπό την επίβλεψη του Καθηγητή Αντωνίου Λοΐζου, με θέμα τον προσδιορισμό των παραμέτρων διατμητικής αντοχής με επιτόπου δοκιμές, και το 1980 ολοκλήρωσε την υφηγεσία του με θέμα τη γεωτεχνική συμπεριφορά των λιγνιτών της Μεγαλόπολης. Μέλος του Διδακτικού Προσωπικού της Σχολής από το 1966, υπηρέτησε ως Επίκουρος Καθηγητής (1982-1984), Αναπληρωτής Καθηγητής (1984-1990), Καθηγητής (1990-2004) και στη συνέχεια Ομότιμος Καθηγητής.

Το ερευνητικό έργο του, το οποίο εστιίασε στην συμπεριφορά των εδαφών, σε θεμελιώσεις με πασσάλους και σε επιτόπου δοκιμές, συνεχίστηκε και μετά την αποχώρησή του από την ενεργό υπηρεσία το 2004. Συνέγραψε 75 άρθρα, επέβλεψε πάνω από 100 διπλωματικές εργασίες και εξέδωσε τέσσερα βιβλία σε συνεργασία με τον Αναπληρωτή Καθηγητή ΕΜΠ Βασίλειο Παπαδόπουλο και ακόμη ένα σε συνεργασία με τον υιό του Γεώργιο Αναγνωστόπουλο και τον Παναγιώτη Ανδρέου (Θεμελιώσεις με πασσάλους Ανδρέας Γ. Αναγνωστόπουλος, Βασίλειος Π. Παπαδόπουλος, Εδαφικές Ιδιότητες από επί Τόπου Δοκιμές Ανδρέας Γ. Αναγνωστόπουλος, Παναγιώτης Ανδρέου, Γεώργιος Α. Αναγνωστόπουλος, Επιφανειακές θεμελιώσεις Ανδρέας Γ. Αναγνωστόπουλος, Βασίλειος Π. Παπαδόπουλος, Επιφανειακές Θεμελιώσεις και Θεμελιώσεις με Πασσάλους Ανδρέας Γ. Αναγνωστόπουλος, Βασίλειος Π. Παπαδόπουλος, Σχεδιασμός των Θεμελιώσεων Ανδρέας Γ. Αναγνωστόπουλος, Βασίλειος Παπαδόπουλος).

Η συμβολή του στη δημιουργία του Τομέα Γεωτεχνικής, τον οποίο και διεύθυνε επί εξαετία και στη συνέχεια στην καθιέρωση της Κατεύθυνσης Γεωτεχνικού Μηχανικού, ήταν καθοριστική. Σε μεταπτυχιακό επίπεδο, συνεργάστηκε με τον Καθηγητή της Σχολής Μηχανικών Μεταλλείων Μεταλλουργών (ΜΜΜ) Χαράλαμπο Τσουτρέλη στη δημιουργία του μεταπτυχιακού προγράμματος σπουδών Σχεδιασμός και Κατασκευή Υπόγειων Έργων που συντονίζει η Σχολή ΜΜΜ.

Διετέλεσε Αναπληρωτής Πρόεδρος (1993-2001) και Πρόεδρος (2001-2003) της Σχολής Πολιτικών Μηχανικών ΕΜΠ. Στη διάρκεια της θητείας του, η Σχολή ολοκλήρωσε τη μετάβαση από το ιστορικό συγκρότημα στο κέντρο της Αθήνας και το κτήριο Γκίνη στις νέες της εγκαταστάσεις και τα νέα διδακτήρια στην Πολυτεχνειούπολη Ζωγράφου.

Στον χώρο των διεθνών συνεργασιών, καθοριστική ήταν η πρωτοβουλία του για τη στρατηγική συμφωνία συνεργασίας της Σχολής Πολιτικών Μηχανικών ΕΜΠ με την École Nationale des Ponts et Chaussées του Παρισιού για την απονομή διπλού διπλώματος σε φοιτητές και φοιτήτριες που παρακολουθούν μαθήματα και στις δύο Σχολές.

Στην προσφορά του εκτός του Ιδρύματος συγκαταλέγονται η πολύχρονη συμμετοχή και δραστηριότητά του σε Οργανισμούς δημόσιου ενδιαφέροντος, επιστημονικές επιτροπές και εταιρείες, και στη διοργάνωση ελληνικών και διεθνών συνεδρίων. Παράλληλα, έχει προσφέρει υπηρεσίες συμβούλου για πολλές μελέτες, συμπεριλαμβανομένης της μελέτης για τη θεμελίωση του Μουσείου Ακρόπολης μαζί με τον Αναπληρωτή Καθηγητή ΕΜΠ Βασίλειο Παπαδόπουλο.

Διετέλεσε μέλος της της Εκτελεστικής Επιτροπής της ΕΕΕΕΓΜ. Γενικός Γραμματέας από το 1979 έως το 2008. Παρουσίασε την 5η Αθηναϊκή Διάλεξη Γεωτεχνικής Μηχανικής το 2008 με τίτλο «Καθιζήσεις Επιφανειακών Θεμελιώσεων». Ήταν Πρόεδρος του XV European Conference on Geotechnical Engineering and Soil Mechanics 2011 στην Αθήνα.

Στην συνέχεια παρατίθεται σύντομο βιογραφικό σημείωμα (στα αγγλικά) και το Υπόμνημα Σταδιοδρομίας του, το οποίο συνέταξε ο ίδιος και συμπλήρωσε, μετά τον θάνατό του, ο υιός του Γεώργιος Αναγνωστόπουλος.

Professor Emeritus Andreas Anagnostopoulos Curriculum Vitae

Andreas Anagnostopoulos was born in Athens on November 30, 1937. He graduated from the School of Civil Engineering of the National Technical University of Athens (NTUA) in 1961. At that time, the curriculum of Civil Engineering included two courses combining Soil Mechanics and Foundations taught by Professor Antonios Loizos, who held the chair of Foundations and Bridges. After his military service, he returned to NTUA in 1964 as a Teaching Assistant and he conducted research for his PhD, under the supervision of Prof. Loizos. In 1966 he joined the teaching staff of NTUA as a Teaching Associate and in 1968 he defended his PhD thesis titled "Determining soil shear strength parameters with in-situ tests". As a visiting scholar in 1977-1978 at Imperial College, he completed a report titled "Analysis of factors affecting the settlements of structures on clay", under the supervision of Professor Alan Bishop, and was awarded the Diploma of Imperial College. In 1980, he completed his thesis for the title "Docent of NTUA" on "Geotechnical behaviour of the Megalopolis lignite". He became Assistant Professor at NTUA in 1982, Associate Professor in 1984 and Full Professor in 1990. After retiring in 2004, he was awarded the title of Emeritus Professor of NTUA.

His teaching activities coincided with and contributed to a significant expansion in the teaching and practice of Geotechnical Engineering in Greece and in the Geotechnical Department of NTUA. As a Teaching Associate, he was involved in

the teaching of courses on Soil Mechanics and Foundations in the Schools of Civil Engineering and Mining Engineering. As an independent instructor, he introduced new topics, such as retaining structures and soil reinforcement. His favourite topic has been foundations and in particular pile foundations. He has written three books on Deep Foundations with Piles (1990, in 2004 he co-authored a 2nd Edition with Vasilios Papadopoulos), Pile Design (1992, with co-authors Stavros Christoulas and Vasilios Papadopoulos), Shallow Foundations (1989, 2002, with co-author Vasilios Papadopoulos) and collaborated with Stavros Christoulas for a book on Selected Applied Topics in Geotechnical Engineering. Apart from NTUA, his books have been used in courses in other Civil Engineering Departments in Greece and by practicing engineers for the design of foundations.

His research focused mainly on soil behaviour, pile foundations and in-situ testing. He has authored 75 papers, on topics such as settlements of Athenian schist, mechanical behaviour of Corinthian marl, use of SPT results for estimating settlements of cohesionless soils, correlations with CPT results for Greek soils, piles in cohesionless soils and jet grouting in Athenian schist. He supervised more than 100 diploma theses at NTUA, encouraging his students while working on their theses to both become familiar with the scientific literature and establish contacts with Greek geotechnical consulting companies.

He was involved in many geotechnical projects, such as the deep-pile foundation of the jetty at Skaramaga Shipyard with Bengt Broms, deep excavations in open pit mines in lignite deposits in Megalopolis and Ptolemais, stabilization of sliding piers of a railway bridge founded on serpentine with Michael Kavvadas, an independent review of the geotechnical design for the Igoumenitsa Port, which involved embankments and gravel piles to control settlements, with Vasilios Papadopoulos and Ilias Michalis, and the foundation of the Acropolis Museum with Vasilios Papadopoulos. In 1994, he was member of the Ministry of Public Works' Committee for the Corinth Canal, which investigated the integrity of the slopes of the canal. He also served for many years as Geotechnical Consultant for the Public Power Corporation, the Hellenic Railways Organization and the Ministry of Public Works.

Professor Anagnostopoulos has been active worldwide since 1981 as chairman, discussion leader and panelist at numerous European and International Conferences in foundation and ground engineering. He delivered lectures in Europe covering topics on foundation engineering, ground improvement, in-situ testing and weak rocks (Athens Schist). He has also been a member of advisory boards and scientific committees at several European Conferences and a member of the editorial board or corresponding member in international scientific journals.

He was an active member of international Technical Committees, including ISSMGE committees on Cone Penetrometer, Allowable Building Deformation and Damage, Geotechnical Laboratory Testing (ETC-5) and Geotechnical Engineering Education (TC31). For several years (1981-1987), he and Dr. D. Coumoulos were members of the ISSMFE ad-hoc Committee for Eurocode 7 (CEN/TC-250). From 1990 to 2007, Professor Anagnostopoulos was member of the Eurocode 7 committee as representative of ELOT (Greek Organization for Standardization). The work in these committees led to the publication of chapters summarizing geotechnical codes and practices in European countries (1987, 1992, ENPC Press) and contributed in the recommendations of the ISSMGE for Geotechnical Laboratory Testing (1998, Beuth Verlag GmbH).

Almost contemporary with the professional life of Professor Andreas Anagnostopoulos, the Hellenic Society for Soil Mechanics and Geotechnical Engineering (HSSMGE) was formed in 1966. He joined it in 1968 and was Secretary General during 1978-2008. He took initiative for the organization of events, including the early scientific meetings on Soil Mechanics and Foundations in 1982 and 1985, which attracted 100 and 200 delegates, respectively. The success of those meetings led to the establishment of the Hellenic Conferences on Geotechnical Engineering, starting with the 1st Hellenic Conference in 1988 in Athens (Chaired by: Panagiotis Kotzias). Professor Anagnostopoulos co-chaired with Professor François Schlosser the 1st International Symposium on Hard Soils – Soft Rocks in 1993 in Athens. In the early 1990s, he established the representation of HSSMGE in the conferences of Young Geotechnical Engineers; the 13th European Young Geotechnical Engineers Conference took place in 1999 in the island of Santorini, chaired by Prof. Michael Kavvadas. In 2001, Professor Anagnostopoulos chaired the 4th Hellenic Conference on Soil Mechanics and Geotechnical Engineering in Athens.

Professor Andreas Anagnostopoulos' contribution to NTUA includes long tenures in senate committees for Undergraduate Curricula and the Research Funding Committee. He was Director of the Foundation Laboratory of the Geotechnical Department during 1986-2004. He oversaw the procurement of all the standard soils equipment and some state-of-the-art equipment (e.g. high pressure testing for soft rocks), so that the laboratory could be used for both teaching and research. In 2003, the Geotechnical Department and the Laboratory moved from downtown Athens to a new spacious building in the Zografou campus of NTUA.

Professor Andreas Anagnostopoulos acted as Head of the Geotechnical Department during the years 1989-93, 1998-99 and 2003-04, Vice-Chairman of the School of Civil Engineering between 1993 and 2001, and Chairman of the School of Civil Engineering from 2001 to 2003. While he was Chairman of the School of Civil Engineering, the Specialization in Geotechnical Engineering was launched. From the two geotechnical courses in the early sixties, the Geotechnical Department offered 13 courses, including specialty courses in Soil Dynamics, Soil-Structure Interaction, Ground Improvement, Rock Mechanics, Computational Geotechnics, and Environmental Geotechnics. In 1998, after a proposal by Mining Engineering Professor Charalambos Tsoutrelis for the creation of a post-graduate course on the Design and Construction of Underground Works, Professor Andreas Anagnostopoulos collaborated with Prof. Tsoutrelis during 1998-1999 for the development of the curriculum of the new programme. Furthermore, during Prof. Anagnostopoulos' term as Chairman, an agreement for a "Double Diploma" between the School of Civil Engineering and the École Nationale des Ponts et Chaussées (ENPC) was signed in 2003.

As an Emeritus Professor, Andreas Anagnostopoulos continued his activities. He delivered the 5th Athenian Lecture of the Hellenic SSMGE in 2008 on the topic of "Settlements of Shallow Foundations". He was the President of the 5th Hellenic Conference on Geotechnical Engineering in 2006 in Xanthi, and of the XVth European Conference on Soil Mechanics and Geotechnical Engineering in 2011 in Athens. Between 2007 and 2013, he was the Chair of the CEN Technical Committee TC 341 covering Laboratory and Field Testing issues for Eurocode 7. In 2014, he co-authored (with Panagiotis Andreou and Georgios Anagnostopoulos) a book on determining soil parameters from in-situ testing.

Ανδρέας Γ. Αναγνωστόπουλος
ΥΠΟΜΝΗΜΑ ΣΤΑΔΙΟΔΡΟΜΙΑΣ

Γεννήθηκε: Αθήνα, 30.11.1937 Έγγαμος, δύο παιδιά

1. Σπουδές

Πολιτικός Μηχανικός Ε.Μ.Π. (1961)

Διδάκτωρ Μηχανικός Ε.Μ.ΙΙ. (Εδαφομηχανική) (1968)

Δίπλωμα του Imperial College στην Εδαφομηχανική (D.I.C.) (1978)

Υφηγητής Ε.Μ.Π. (Εδαφομηχανική - Θεμελιώσεις) (1980)

2. Γλώσσες

Αγγλικά Γαλλικά

3. Πανεπιστημιακή Σταδιοδρομία

Άμισθος Επιμελητής ΕΜΠ 1963

Έμμισθος Βοηθός ΕΜΠ 1965

Έμμισθος Επιμελητής ΕΜΠ 1966

Εντεταλμένος Υφηγητής ΕΜΠ 1981

Επίκουρος Καθηγητής ΕΜΠ 1982

Αναπληρωτής Καθηγητής ΕΜΠ 1984

Καθηγητής ΕΜΠ 1990

Υπηρέτησα ως:

Διευθυντής Εργαστηρίου Θεμελιώσεων (1986-2004)

Διευθυντής Τομέα Γεωτεχνικής (1989-90, 1990-91, 1992-93, 1997-98,2003-2004)

Διευθυντής Τομέα Προγραμματισμού και Διαχείρισης Τεχνικών Έργων (1994-95, 1995-96, 1999-00,2000-01)

Αναπληρωτής Πρόεδρος Σχολής Πολιτικών Μηχανικών (1993 -2001)

Πρόεδρος Σχολής Πολιτικών Μηχανικών (2001-2003)

Μέλος Συγκλήτου ΕΜΠ

4. Συμμετοχή σε Επιτροπές ΕΜΠ

Συγκλητική Επιτροπή Προπτυχιακών Σπουδών

Επιτροπή Ερευνών

Επιτροπή Φοιτητικής Λέσχης

Επιτροπή Κληροδοτημάτων

ΕΔΕ-ΔΠΜΣ «Σχεδιασμός και Κατασκευή Υπογείων Έργων»

Επιτροπή για τη Συνεργασία Σχολής Π.Μ.-ENPC (Χορήγηση διπλού Διπλώματος)

5. Μέλος Επιστημονικών Επιτροπών

- Επιτροπή CEN/TC-250: Eurocode 7 - Geotechnical design (1989-2013)
- Επιτροπών της Διεθνούς Επιστημονικής Εταιρίας Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ISSMGE):
  - Τεχνικής Υποεπιτροπής για τις «Πενετρομετρήσεις» (1977-1978)
  - Επιτροπή «Κοινών Ενοποιημένων Κανονισμών για Γεωτεχνικές Μελέτες, Ευρωκώδικας 7» (1981-87)
  - Τεχνική Επιτροπή για τις «Επιτρεπόμενες Παραμορφώσεις Κτιρίων και Σχετικές Βλάβες» (1982-1985)
  - Ευρωπαϊκή Τεχνική Επιτροπή «Εργαστηριακές Δοκιμές Γεωτεχνικής: ETC-5» (1991-1996)
  - Τεχνική Επιτροπή για την «Εκπαίδευση στη Γεωτεχνική Μηχανική: TC-31» (1997-2001)
  - Πρόεδρος Ευρωπαϊκής Κανονιστικής Επιτροπής CEN Geotechnical Investigations: Laboratory and in-Situ Testing, CEN/TC-341 (2007 – 2013)

6. Μέλος Ελληνικών Επιστημονικών Επιτροπών

- Τεχνικής Επιτροπής του ΕΛΟΤ/ΤΕ67: Ευρωκώδικας 7 – Γεωτεχνικός Σχεδιασμός και Εθνικός Εκπρόσωπος του Ελληνικού Οργανισμού Τυποποίησης (ΕΛΟΤ) στην Ευρωπαϊκή Επιτροπή Ευρωκώδικας 7: Γεωτεχνικός Σχεδιασμός (CEN/TC250/SC7) (1989 - 2013)
- Επιτροπή ΥΠΕΧΩΔΕ: Τυποποίησης Γεωτεχνικών Μελετών
- Επιτροπή ΥΠΕΧΩΔΕ: Προδιαγραφές Γεωτεχνικής (1999)
- Επιτροπή ΙΟΚ: Προδιαγραφές Γεωτεχνικών Έργων (2002)
- Επιτροπή ΥΠΕΧΩΔΕ: Εφαρμογές Ευρωκωδίκων στην Ελλάδα (2002 - 2013)

7. Μέλος Επιστημονικών Ενώσεων-Εταιρειών

- του Τεχνικού Επιμελητηρίου της Ελλάδος
- του Συλλόγου Πολιτικών Μηχανικών Ελλάδος
- της Ελληνικής Εταιρείας Εδαφομηχανικής και Θεμελιώσεων / Ελληνικής Επιστημονικής Εταιρείας Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (Γενικός Γραμματέας 1979 – 2008)
- της Διεθνούς Εταιρείας Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ISSMGE)
- της Διεθνούς Εταιρείας Βραχομηχανικής (ISRM)
- της Βρετανικής Γεωτεχνικής Εταιρείας (BGS)

8. Μέλος Συντακτικών Επιτροπών Περιοδικών

- του περιοδικού του «Κέντρου Ερευνών Δημοσίων Έργων», Αθήνα (1985-2009)
- του περιοδικού «Geotechnical Engineering» (Ινστιτούτο Πολιτικών Μηχανικών), Λονδίνο (1995-1999)
- του περιοδικού «Geotechnical and Geological Engineering», Durham, U.K. (1993-2019)

9. Διδακτικό Έργο

α) Διδασκαλία Μαθημάτων

- Δίδαξα ως Βοηθός-Επιμελητής Φροντιστηριακές ασκήσεις καθώς και με εντολή διδασκαλίας ως Επιμελητής ή Εντεταλμένος Υφηγητής επί 15 έτη
- Επίσης ως μέλος ΔΕΠ δίδαξα επί 22 έτη. Συγκεκριμένα:
  - Ως βοηθός/Επιμελητής κατά τα έτη 1965-69 συμμετείχα σε φροντιστηριακές ασκήσεις όλων των μαθημάτων Εδαφομηχανικής και Θεμελιώσεων.
  - Ως Επιμελητής ΕΜΠ συμμετείχα με φροντιστηριακή διδασκαλία στα μαθήματα Εδαφομηχανικής, Θεμελιώσεων, Θεμελιώσεις-Ειδικά θέματα, Θεμελιώσεις-Ειδικές Κατασκευές, Εδαφομηχανική και Στοιχεία Θεμελιώσεων (Σχολή ΜΜΜ) κατά τα έτη 1969-1979
  - Εντολή διδασκαλίας ως Επιμελητής για το Ακαδημαϊκό έτος 1980-81 στα μαθήματα: Εδαφομηχανική (Γενικό Μέρος) και Θεμελιώσεις-Ειδικές Κατασκευές
  - Εντολή διδασκαλίας ως Εντεταλμένος Υφηγητής το Ακαδημαϊκό έτος 1981-82 στα μαθήματα: Θεμελιώσεις-Ειδικά Θέματα, Θεμελιώσεις-Ειδικές Κατασκευές, Εδαφομηχανική και Στοιχεία Θεμελιώσεων (Σχολή ΜΜΜ).
  - Ως Επίκουρος Καθηγητής (1982-84) συνέχισα την διδασκαλία των μαθημάτων που μου είχαν ανατεθεί ως Εντεταλμένος Υφηγητής.
  - Ως Αναπληρωτής Καθηγητής (1984-89) έχω διδάξει: Θεμελιώσεις, Θεμελιώσεις-Ειδικά θέματα (συνδιδασκαλία με τον Λέκτορα κ. Β. Παπαδόπουλο από το 1985), Θεμελιώσεις-Ειδικές Κατασκευές (1984-85) και Εδαφομηχανική και Στοιχεία Θεμελιώσεων (συνδιδασκαλία με τον Λέκτορα κ. Β. Παπαδόπουλο από το 1985).
  - Ως Καθηγητής (1990-2004) έχω διδάξει: Θεμελιώσεις (συνδιδασκαλία με τον Επίκ. Καθηγητή Β. Παπαδόπουλο), Ειδικά θέματα Θεμελιώσεων (συνδιδασκαλία με τον Καθηγητή Γ. Μπουκοβάλα), Εδαφομηχανική και Στοιχεία Θεμελιώσεων (συνδιδασκαλία με τον Επίκ. Καθηγητή Β. Παπαδόπουλο) ως το 2002.
- Στο ΔΠΜΣ «Σχεδιασμός και Κατασκευή Υπογείων Έργων» έχω διδάξει από το 1999:
  - Αβαθείς Σήραγγες. Αντιστηρίξεις. Καθιζήσεις στην επιφάνεια του εδάφους.
  - Μέθοδοι διερεύνησης του υπεδάφους (Συνδιδασκαλία με Γ. Τσιαμπάο και Σ. Σταματάκη).

β) Επίβλεψη Διπλωματικών και Μεταπτυχιακών Εργασιών

Επέβλεψα περί τις 100 Διπλωματικές Εργασίες πολλές από τις οποίες είχαν ερευνητικό χαρακτήρα (π.χ. εργαστηριακές, σύγχρονες μέθοδοι βελτιώσεως εδάφους, μέθοδοι εκτιμήσεως καθιζήσεων κλπ.) και οι οποίες καλύπτουν ευρύ φάσμα των αντικειμένων της Γεωτεχνικής. Ενδεικτικά αναφέρονται οι επιστημονικοί τομείς στους οποίους εμπίπτουν οι ανωτέρω εργασίες:

i. Διερεύνηση μηχανικής συμπεριφοράς εδαφικών σχηματισμών
ii. Ασυνήθεις εδαφικοί σχηματισμοί ή εδάφη με ειδική μηχανική συμπεριφορά (λιγνίτες Μεγαλοπόλεως και Πτολεμαΐδας, τσιμεντωμένοι σχηματισμοί-μάργες Κορίνθου κλπ.)
iii. Εκτίμηση καθιζήσεων συνεκτικών και μη συνεκτικών εδαφών
iv. Βαθιές θεμελιώσεις
v. Σύγχρονες μέθοδοι βελτιώσεως εδάφους (χαλικοπάσσαλοι, jet grouting)
vi. Ερμηνεία αποτελεσμάτων επί τόπου δοκιμών.

Επίσης επέβλεψα 9 Μεταπτυχιακές εργασίες στα πλαίσια των μαθημάτων του ΔΠΜΣ «Σχεδιασμός και Κατασκευή Υπογείων Έργων» κυρίως στα ερευνητικά αντικείμενα:

i. Επίδραση της ανηγμένης αντοχής βραχόμαζας στην συμπεριφορά των σηράγγων
ii. Καθιζήσεις επιφανείας λόγω αβαθών σηράγγων.

γ) Διδακτορικές Διατριβές

- Ως επιβλέπων 1
- Μέλος Συμβουλευτικών Επιτροπών 5
- Σε συνεργασία με τον Καθηγητή Α. Λοΐζο.
  - Ως Σύμβουλος στη Διδακτορική Διατριβή του Δρ. Β. Παπαδόπουλου
  - Ως Υπεύθυνος της εργαστηριακής έρευνας στη Διδακτορική Διατριβή του Δρ. Galal El Abd
- Μέλος Επταμελών Εξεταστικών Επιτροπών εκτός ΕΜΠ: 2 στο Τμήμα ΠΜ του ΑΠΘ και 3 στο Τμήμα ΠΜ του Πανεπιστημίου Πατρών.

10. Ερευνητικό Έργο

α) Εκσυγχρονισμός του Εργαστηρίου Θεμελιώσεων

Από το 1980 καταβλήθηκαν συνεχείς προσπάθειες για τον εκσυγχρονισμό και την λειτουργία του Εργαστηρίου Θεμελιώσεων τόσο για εκπαιδευτικούς όσο και για ερευνητικούς σκοπούς (εκπόνηση Δ/Ε, διδακτορικών διατριβών και ερευνητικών προγραμμάτων).

β) Περιοχές Ερευνητικού Έργου

➢ Στην ευρύτερη περιοχή της Εδαφομηχανικής ασχολήθηκα με θέματα:
  - Διερευνήσεως μηχανικής συμπεριφοράς των εδαφικών σχηματισμών
  - Διερεύνηση συμπεριφοράς ασυνηθών σχηματισμών (τσιμεντωμένων, οργανικών κλπ.)

Στην υπόψη περιοχή εμπίπτουν 12 σχετικές επιστημονικές δημοσιεύσεις.

➢ Στην ευρύτερη περιοχή των Θεμελιώσεων – Εφαρμοσμένης Γεωτεχνικής ασχολήθηκα με θέματα:
  - Ερμηνείας αποτελεσμάτων επί τόπου δοκιμών, για θεμελιώσεις
  - Εκτίμηση καθιζήσεων (συνεκτικών και μη συνεκτικών εδαφών)
  - Βαθειών θεμελιώσεων
  - Συγχρόνων μεθόδων βελτιώσεως του εδάφους (χαλικοπάσσαλοι, jet grouting)
  - Επιπτώσεων από την διάνοιξη σηράγγων

Στην υπόψη περιοχή εμπίπτουν 44 επιστημονικές δημοσιεύσεις και 3 διδακτικά – τεχνικά βιβλία.

γ) Συναφείς Επιστημονικές Δραστηριότητες

- Επίβλεψη διδακτορικών διατριβών
- Συμμετοχή σε 3μελείς Συμβουλευτικές Επιτροπές εκπονήσεως Δ/Δ και σε εξεταστικές επιτροπές
- Υπεύθυνος Ερευνητικών Προγραμμάτων
- Ενεργή συμμετοχή σε Διεθνείς Επιτροπές Συνέδρια κλπ.

11. Τεχνική - Εφαρμοσμένη Επιστημονική Δραστηριότητα

α) Γεωτεχνικές Έρευνες - Μελέτες Γεωτεχνικών Έργων

Ως Γεωτεχνικός Μελετητής ασχολήθηκα επί 35 περίπου έτη με την εκπόνηση ή συμμετοχή στην εκπόνηση μεγάλου αριθμού γεωτεχνικών ερευνών και μελετών θεμελιώσεων και άλλων γεωτεχνικών έργων. Μεταξύ των υπόψη ερευνών - μελετών σημαντικός αριθμός αφορά ειδικές περιπτώσεις ή ειδικά γεωτεχνικά έργα, όπως:

- Αρνητικές τριβές επί πασσάλων
- Θεμελιώσεις ή έργα σε ασυνήθεις σχηματισμούς (κοραλλιογενείς, λιγνίτες, ημίβραχοι, ειδικής συμπεριφοράς κλπ.)
- Αντιστηρίξεις με προεντεταμένες αγκυρώσεις.
- Βελτιώσεις εδάφους (προφορτίσεις, χαλικοπάσσαλοι, κλπ.)

β) Χρηματοδοτούμενα Ερευνητικά Προγράμματα – Υπηρεσίες Συμβούλου και Πραγματογνώμονος

Συμμετοχή σε μεγάλο αριθμό ερευνητικών προγραμμάτων ή σε περιπτώσεις παροχής Υπηρεσιών Συμβούλου ή Πραγματογνώμονος για λογαριασμό του Δημοσίου, Οργανισμών Δημοσίου Ενδιαφέροντος ή Τοπικής Αυτοδιοίκησης, με αντικείμενα θεμελιώσεων, ευστάθειας πρανών, βελτιώσεις εδαφών, προβλήματα σηράγγων, εκπόνηση μικροζωνικών μελετών κλπ.

ΠΑΡΑΡΤΗΜΑ

Α. Επιστημονικές Δημοσιεύσεις

1. Loizos A., **Anagnostopoulos A.** (1970): "A contribution on the determination of shear strength characteristics of soils by means of in situ tests". International Geotechnical Conference. Pahlavi University Shiraz, Iran, pp 1-29.
2. **Anagnostopoulos A.** (1973): "Interpretation of Dutch Cone test results in soft clays". 8th International Conference on Soil Mechanics and Foundation Engineering. Moscow, vol 4.2, pp 31-33
3. Tassios Th., **Anagnostopoulos A.** (1974): "Penetration testing in Greece. State-of-the-art Report". Proc 1st European Symposium on Penetration Testing. Stockholm, Vol. 1, pp. 65-68.
4. **Anagnostopoulos A.** (1974): 'Evaluation of the undrained shear strength from static cone penetration tests in a soft silty clay in Patras". Proc 1st European Symposium on Penetration Testing. Stockholm, vol. 2.2, pp 13-14.
5. **Anagnostopoulos A.** (1976): "Pile group settlement in cohesive soils with linearly increasing modulus of compressibility (Eg)". 6th European Conference on Soil Mechanics and Foundation Engineering. Wien, vol 2.2, pp 197-198
6. **Anagnostopoulos A.,** Papadopoulos B. (1977): "Shear strength anisotropy of stratified soils". Proc 9 International Conference on Soil Mechanics and Foundation Engineering. Tokyo, Vol. 1, pp 15-17.
7. Papadopoulos B., **Anagnostopoulos A.** (1977): "Differential settlements in non homogeneous soils". Proc 9th International Conference on Soil Mechanics and Foundation

Engineering. Tokyo, Vol. 1, pp 687-690.

8. **Anagnostopoulos A.** (1979): "Correlation of the stress-level and the compressibility of sands". Proc 7th European Conference on Soil Mechanics and Foundation Engineering. Brighton, Vol. 4, pp 262-265
9. **Αναγνωστόπουλος Α.** και 8 συνεργάτες (1977): "Ζεύξη Ρίου - Αντιρρίου με υποβρύχιο σήραγγα με αγωγούς". Συνέδριο "Ζεύξης Ρίου - Αντιρρίου", Πάτρα, σελ. 489-522
10. **Anagnostopoulos A.,** Papadopoulos B. (1980): "Stability analysis of slopes in anisotropic soils". Proc 6th Danube - European Conference on Soil Mechanics and Foundation Engineering. Varna, pp 17-26
11. **Αναγνωστόπουλος** Α. (1981): "Η πλαστικότης του Αθηναϊκού Σχιστολίθου". Ημερίδα ΤΕΕ: Γεωτεχνικά προβλήματα του Αθηναϊκού Σχιστολίθου. Αθήνα, σελ. 136-142
12. **Αναγνωστόπουλος** Α. (1981): "Η συμπιεστότης του Αθηναϊκού Σχιστολίθου". Ημερίδα ΤΕΕ: Γεωτεχνικά προβλήματα του Αθηναϊκού Σχιστολίθου. Αθήνα, σελ. 162-179
13. **Αναγνωστόπουλος Α.** (1981): "Υπολογιστικά πρότυπα καθιζήσεων στον Αθηναϊκό Σχιστόλιθο". Ημερίδα ΤΕΕ: Γεωτεχνικά προβλήματα του Αθηναϊκού Σχιστολίθου. Αθήνα, σελ. 299-302
14. Papadopoulos B., **Anagnostopoulos A.** (1981): "Factors affecting the stability of slopes". Proc 10th International Conference on Soil Mechanics and Foundation Engineering. Stockholm, Vol. 3, pp 501-504.
15. **Anagnostopoulos A.** (1981): Panel Discussion in Session: "Soil Exploration". 10th International Conference on Soil Mechanics and Foundation Engineering. Stockholm, Vol. *4,* pp 762-763
16. **Anagnostopoulos A.G.,** Papadopoulos B.P. (1982): "SPT and the compressibility of cohessionless soils". Proc. 2nd European Symposium on Penetration Testing - ESOPT Π. Amsterdam, Vol. 1, pp 25-28
17. **Αναγνωστόπουλος Α.** (1982): Γενική Εισήγηση "Μαλακές αποθέσεις του Τεταρτογενούς στην Ελλάδα". 1η Ελληνική Ημερίδα Γεωτεχνικής. Αθήνα, σελ. 135-146
18. **Αναγνωστόπουλος Α.** (1982): "Προϊστορία των φορτίσεων και μηχανική συμπεριφορά λιγνιτικού υλικού. 1η Ελληνική Ημερίδα Γεωτεχνικής. Αθήνα, σελ. 303-305
19. **Anagnostopoulos A.G.** (1982): "Résistance en compression d' un lignite terrigène". Revue Franchise de Geotechnique, No. 18, pp. 21-27
20. **Anagnostopoulos A.G.** (1982): "Compressibility behaviour of a soft lignite". Journal of the Geotechnical Engineering Division, ASCE, vol 108, No GT 12, pp 1549-1566
21. **Αναγνωστόπουλος Α.,** Καλτεζιώτης Ν., Τσάμης Β. (1985): Γενική Εισήγηση: "Επιλογή παραμέτρων διατμητικής αντοχής". 2η Ελληνική Ημερίδα Γεωτεχνικής, Αθήνα, σελ. 54-106
22. **Αναγνωστόπουλος Α.** (1985): "Βαθειά συμπύκνωση με δονούμενο στέλεχος". 2η Ελληνική Ημερίδα Γεωτεχνικής, Αθήνα, σελ. 509-512
23. **Αναγνωστόπουλος Α.,** Καλτεζιώτης Ν. (1985): "Αρχές για την εκτίμηση της διατμητικής αντοχής των εδαφών". Δελτίο ΚΕΔΕ, τεύχος 1-2, σελ. 108-135
24. **Αναγνωστόπουλος Α.,** Τζάβελος Χ. (1987): "Πάσσαλοι μεγάλης διαμέτρου σε μη συνεκτικά εδάφη". Έρευνα και Σχεδιασμός. Δελτίο Κέντρου Ερευνών Δημοσίων Έργων, Τεύχος 3, σελ. 185-198
25. Drettas Gr., Panagopoulos **P., Anagnostopoulos A.,** Papadopoulos B. (1987): "Evaluation of bearing capacity of piles during driving". Proc. Baltic Conference on Design, Construction and Maintenance of Harbour Structures, Norrkoping, Sweden
26. Papadopoulos B., **Anagnostopoulos A.** (1987): "Groundwater effects on settlements estimation". 9th European Conference on Soil Mechanics and Foundation Engineering, Dublin, Vol. 2, pp 725-729
27. **Αναγνωστόπουλος** Α. (1988): "Κρίσιμο βάθος: Έρευνες και Προβληματισμοί". 1° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Αθήνα, τόμος 2, σελ. 161-166.
28. Παπαδόπουλος **Β., Αναγνωστόπουλος Α.** και Ζουρίδης Α. (1988): "Πεδιλοδοκοί επί ελαστικού ημιχώρου". 1° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Αθήνα, Τόμος 2, σελ. 209-214
29. **Anagnostopoulos A.,** Papadopoulos B., Sideris I., Kamariotis A. (1988): "The Compressibility of Ptolemais Lignite". Δελτίο Κέντρου Ερευνών Δημοσίων Έργων, Τεύχος 3-4, σελ. 87-97
30. **Αναγνωστόπουλος** Α. (1988): "Γενική Εισήγηση Συνεδρίας 7: Θεμελιώσεις". 1° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Αθήνα 1988, Τομ. 3, σελ. 153-157
31. **Anagnostopoulos A.,** Papadopoulos B. (1989): "Stabilité des talus dans les sols cohérents anisotropes". Bulletin Liaison Laboratoires Ponts et Chaussées, No. 164, pp. 33-41
32. Kalteziotis N., **Anagnostopoulos A.,** Bouckovalas G., Pachakis M., Papadopoulos B., Christoulas S. (1989): "Experience from the first on-shore application of Marchetti dilatometer in Greece". Δελτίο Κέντρου Ερευνών Δημοσίων Έργων, Τεύχος 1-2, σελ. 3-14
33. Sorianos A, Constantinidis K, Christodoulias I. and **Anagnostopoulos A.** (1988): "Rockfall analysis at the ancient region of Argos". Proc. International Symposium on Engineering Geology as related to the study, preservation and protection of ancient works, monuments and historical sites. Athens, September 1988, vol I, pp 213-216
34. **Anagnostopoulos A.** Christoulas St., Kalteziotis N., Tsiambaos G. (1989): "Some geotechnical aspects of marls of Corinth Canal". Proc. 12th International Conference of Soil Mechanics and Foundation Engineering, Rio de Janeiro, vol 1, pp 491-494
35. **Anagnostopoulos A.,** (1990): "Die zusammendr-Ockbarkeit nichtbindiger boeden". Geotechnik, Heft 4, pp. 181-187
36. **Anagnostopoulos A.,** Kalteziotis N., Tsiambaos G., Kawadas M. (1991): "Geotechnical properties of the Corinth Canal marls". Geotechnical and Geological Engineering, International Journal, vol 9, pp. 1-26
37. **Anagnostopoulos A.**, Papadopoulos B., Kawadas M. (1991): "Direct estimation of settlements of sand, based on SPT results". Proceedings 10th European Conference on Soil Mechanics and Foundation Engineering, Florence, vol. 1, pp. 293-296
38. Kawadas M., Marinos P., **Anagnostopoulos A.** (1992): "Stability of open pit slopes in Ptolemais Greece". Proc. 6th Int Symp. on Landslides. Christchurch -New Zealand, pp. 1293-1298
39. **Αναγνωστόπουλος Α.**, Ζερβογιάννης Χ., Καλτεζιώτης Ν., Frank R., Χριστούλας Στ. (1992): "Όργανομετρικές δοκιμαστικές φορτίσεις πασσάλων στην Ελλάδα" (Instrumented pile-load tests in Greece). 2° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Θεσσαλονίκη Τόμ 1, σελ. 173-180
40. **Αναγνωστόπουλος Α.** (1992): "Επιτρεπόμενη φόρτιση στις επιφανειακές θεμελιώσεις: Μερικές σκέψεις για τις εφαρμογές", (Allowable pressure on spread foundations: Some practical considerations). Δελτίο Συλ. Πολ. Μηχ. Ελλάδος αρ. 207, σελ. 31-37
41. Kavvadas M., **Anagnostopoulos A.** and Kalteziotis N. (1993): Ά framework for the mechanical behaviour of the cemented Corinth, marl", Proc. Int Symp. on Hard Soils - Soft Rocks, Athens, Greece, pp. 577-583
42. Kavvadas M., **Anagnostopoulos A.**, Leonardos M. and Karras B. (1993): "Mechanical properties of the Ptolemais lignite", Proc. Int Symp. on Hard Soils - Soft Rocks, Athens, Greece, pp. 585-592

43. **Αναγνωστόπουλος Α.,** Καλτεζιώτης Ν., Χριστούλας Στ., Παπαδόπουλος Β. (1993): "Παράμετροι παραμορφωσιμότητας σε μη συνεκτικά εδάφη" (Deformability parameters in cohessionless soils). Δελτίο ΚΕΔΕ, τεύχος 117-120, σελ. 41-52

44. Καββαδάς Μ., **Αναγνωστόπουλος Α.** (1993): "Εφαρμογή του Ευρωκώδικα 7 στις γεωτεχνικές μελέτες" 3° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Πάτρα, Τόμ. 2, σελ. 393-400

45. Steensen - Bach J.Q., Bouckovalas G., **Anagnostopoulos A.**, Steenfelt J.S., (1994): "Cyclic loading response of model anchor piles in clay". Proc. 13th Int Confer, on Soil Mechanics and Foundation Engineering, N. Delchi, India, vol 3, pp. 673-376

46. Kavvadas M., Marinos P., **Anagnostopoulos** A., (1994): "Evaluation of the abutments stability of a ninety-year-old railway bridge founded on serpentine", Proc. 7th Congress IAEG, Lisbon, Portugal, pp. 4029-4036

47. Kavvadas M., **Anagnostopoulos A.**, (1995): "A framework for the mechanical behaviour of bonded soils", Proc. 11 European Conf. on Soil Mechanics and Foundation Engineering, Copenhagen, Denmark, vol. 3, pp. 113-118

48. **Anagnostopoulos A.**, Papadopoulos B., (1995): "Restraint of an active landslide by bored piles". Proc. B. Broms Symposium on Geotechnical Engineering, Nanyang Tech. University, Singapore, pp. 27-38

49. Bouckovalas G., **Anagnostopoulos A.**, Kapenis A, Karantoni T. (1996): "Analysis of soil effects and distribution of damage from the Pyrgos (1993) earthquake". Geotechnical and Geological Engineering. International Journal, No 14, pp. 111-128

50. Καββαδάς Μ., **Αναγνωστόπουλος Α.** (1996): "Εφαρμογή του Ευρωκώδικα 7 στη μελέτη γεωτεχνικών έργων". ΔΕΛΤΙΟ Κ.Ε.Δ.Ε., Τεύχος 125-132/1995-1996, σελ. 3-23

51. Pachakis M., **Anagnostopoulos A.**, Tsiambaos G., (1997): "Landslide stabilization by large diameter piles". Proc. Int Symp. on Engineering Geology and the Environment, Athens, Greece, pp. 937-942.

52. **Anagnostopoulos A.**, Michalis I, (1997): "Jet grouting experience in soft rock conditions", Panel discussion. Proc. 14th Int. Conf. on Soil Mechanics and Foundation Engineering, Hamburg, Germany, pp. 2479-2480

53. Kavvadas M., **Anagnostopoulos A.,** (1998): "A framework for the mechanical behaviour of structured soils". Proc. 2nd Int. Symp. on Hard Soils - Soft Rocks, Naples, Italy, pp. 591-602

Α. Αναγνωστόπουλος, Π. Μαρίνος, Μ. Καββαδάς

54. Michalis I.K, **Anagnostopoulos A.** (1999): "Estimation of surface settlements due to urban tunneling in weak rock conditions". Proc. 12th European Conference on Soil Mechanics and Geotechnical Engineering, Amsterdam, vol. 3, pp 2073-2078

55. Γεωργιάννου **Β., Αναγνωστόπουλος Α.** (2001): "Στιφρές άργιλοι: Αντοχή μετά την θραύση". 4° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Αθήνα, Τόμ. 1 σελ. 35-40

56. Λοϊζος Α., **Αναγνωστόπουλος Α.** (2001): "Εκτίμηση των μηχανικών χαρακτηριστικών υλικών οδοστρωσίας". 4° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Αθήνα, Τόμ. 1, σελ. 331-338

57. Μιχάλης Η., Παπαδόπουλος Β., **Αναγνωστόπουλος Α.** (2001): "Η χρήση χαλικοπασσάλων ως στοιχείων ενισχύσεως της διατμητικής αντοχής του εδάφους θεμελίωσης επιχωμάτων" 4° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Τόμ. 1 σελ. 451-458

58. Καββαδάς Μ., Frank **R., Αναγνωστόπουλος Α.** (2001): "Εφαρμογές των μεθόδων ανάλυσης γεωτεχνικών έργων μέσω οριακών καταστάσεων κατά τον Ευρωκώδικα 7". 4° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Αθήνα, Τόμ. 2, σελ 17-24

59. Michalis I.K., Kavvadas M.J., **Anagnostopoulos A.G.** (2001): "Tunnel Stability Factor - A new parameter for weak rock-tunneling". Proc. 15th Inter Conference Soil Mechanics and Geotechnical Engineering", vol 2,1043-1046

60. Kavvadas M., **Anagnostopoulos A.**, Georgiannou V. and Bardanis M. (2002):" Characterization and engineering properties of the Corinth marl". ISSMGE TC-29, Workshop on the characterisation of engineering properties of soils, Singapore, pp 1-20

61. **Anagnostopoulos A.**, Koukis, G, Sabatakakis N. and Tsiambaos G. (2003): "Empirical correlations of soil parameters based on Cone Penetration Tests (CPT) for Greek Soils". Geotechnical and Geological Engineering Int. Journal, vol. 21, pp377-387

62. Michalis I., Papadopoulos B., **Anagnostopoulos A.** and Vlavianos G (2003): "The contribution of stone columns to the improvement of the stability conditions of embankments on soft clays". Proc. 13th International Conference on Soil Mechanics and Geotechnical Engineering. Prague, vol. 1, pp. 827-832

63. Μιχάλης Η., **Αναγνωστόπουλος Α.,** Αναγνωστόπουλος Γ., (2006), «Κριτήρια εδαφικών μετακινήσεων και κατηγορίες βλαβών κτιρίων λόγω διανοίξεως αβαθών σηράγγων». 5ο Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Ξάνθη, Τόμος 4, σελ. 115-124

64. Mihalis I., **Anagnostopoulos A.**, Anagnostopoulos G. and Doulis G. (2007): "Estimation of Ground Surface Settlements due to Tunneling in Weak Rock Conditions based on Tunnel Stability Factor". Proc. 14th European Conference on Soil Mechanics and Geotechnical Engineering, Madrid, Vol. II, pp. 985-990

65. Mihalis I., Konstantis S., **Anagnostopoulos A.**, Vlavianos G. and Doulis G. (2009): "Tunnel Stability Factor – A New Controlling Parameter for the Face Stability Conditions of Shallow Tunnels in Weak Rock Environment". Proc. 17th International Conference on Soil Mechanics and Geotechnical Engineering, Alexandria, Egypt, Vol. 3, pp. 2499-2502

66. Ανδρέου Π., Παπαδόπουλος Β. και **Αναγνωστόπουλος Α.** (2010): «Προτάσεις από την εφαρμογή χαλικοπασσάλων σε συνεκτικά εδάφη». Πρακτικά 6ου Πανελληνίου Συνεδρίου Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Βόλος

67. Κοζομπόλης Α., Βέττας Π., **Αναγνωστόπουλος Α.** και Χλιμίντζας Γ. (2010): «Δυναμική Συμπύκνωση Χαλαρών Κοκκωδών Εδαφών: Σύγκριση Αποτελεσμάτων Μεταξύ Συμβατικών και Νεότερων Μεθόδων». Πρακτικά 6ου Πανελληνίου Συνεδρίου Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Βόλος

68. Papadopoulos V. and Anagnostopoulos A. (2011): "Geotechnical Issues of the New Acropolis Museum". Proc. 15th European Conference on Soil Mechanics and Geotechnical Engineering, Athens, Vol. 3, pp. 1871-1878

69. Vettas P., Pachakis M., Chlimintzas G., Plytas C., Baltzoglou A., Koutalia, Ch. and **Anagnostopoulos A.**

(2011): "Landslide Stabilization at the 'Egnatia Odos' Highway, Greece – Instrumentation, Remediation Options and Numerical Modelling". Proc. Geotechnical Symposium in Balkan Region, Tirana, Albania

70. Efthymiou S., **Anagnostopoulos A.**, Kavvadas M. (2019): "Effect of fly ash on the behaviour of a high plasticity clay", Proc. 17th European Conference on Soil Mechanics and Geotechnical Engineering, Reykjavík

Β. Δημοσιεύσεις για την Εκπαίδευση στη Γεωτεχνική

1. Μαρίνος Π., Χριστούλας Σ., **Αναγνωστόπουλος Α.,** Καλτεζιώτης Ν. (1991): "Έρευνα και Τεχνολογία στο χώρο της Γεωτεχνικής Μηχανικής. Μια πρόταση", (Research and Engineering Practice in Geotechnics). "Τεχνικά Χρονικά, Ειδικό Τεύχος" "Έρευνα - Τεχνολογία"
2. **Αναγνωστόπουλος Α.** (1997): "Σκέψεις για τη διδασκαλία γεωτεχνικής σε πολιτικούς μηχανικούς". 3° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Πάτρα, Τόμ. 2, σελ. 403-408
3. **Αναγνωστόπουλος Α.,** Παπαδόπουλος Β. (1997): "Διδασκαλία Γεωτεχνικής σε πολιτικούς μηχανικούς", Πανελλήνιο Συνέδριο Τμημάτων Πολιτικών Μηχανικών, Θεσσαλονίκη, σελ. 97-104
4. Atmatzidis **D., Anagnostopoulos A.** (2000): "Geotechnical engineering education in Greece". Proc. 1st Intern. Conference on Geotechnical Engineering Education and Training, Sinaia-Romania, pp 123-125

Γ. Κεφάλαια σε Βιβλία

1. **Αναγνωστόπουλος Α.,** Ανδρικοπούλου Κ, Παπαδόπουλος Β.: Κεφάλαιο 5. "Βαθείαι Θεμελιώσεις δια πασσάλων", του Συγγράμματος του Καθηγητού Α. Λοΐζου Εδαφομηχανική-Θεμελιώσεις, Τόμος ΠΙ, Έκδοση ΕΜΠ, 1984, σελ. 217-334
2. **Anagnostopoulos A.,** Zervogiannis Ch.: "La Réglementation Géotechnique en Grèce". Έκδοση La Réglementation Française et Etrangère en Géotechnique από την Presses de Γ Ecole Nationale des Ponts et Chaussées, Paris, 1987, pp 69-79
3. **Anagnostopoulos A.,** Zervogiannis Ch.: "La Réglementation Géotechnique dans les Autres Pays de la CEE". Έκδοση La Réglementation Française et Etrangère en Géotechnique από την Presses de Γ Ecole Nationale des Ponts et Chaussées, Paris, 1987, pp 81-89
4. **Anagnostopoulos A.,** Zervogiannis Ch.: "La situation en Grèce". Έκδοση La Pratique de la Géotechnique dans Γ Europe des 12. Presses ENPC, Paris, 1992, pp. 67-84
5. **Anagnostopoulos A.,** Zervogiannis Ch.: "Les textes de référence". Έκδοση La Pratique de la Géotechnique dans Γ Europe des 12. Presses ENPC, Paris, 1992, pp. 149-156
6. Frank R., Christoulas S., Zervogiannis Ch., Kalteziotis N., **Anagnostopoulos A.:** "Essais de pieux instrumentés en Grèce" Αφιέρωμα στον Δ. Βαλαλά, Έκδοση Α.Π.Θ. Πολυτεχνική Σχολή, Τμήμα Πολιτικών Μηχανικών, Θεσσαλονίκη, 1995, σελ. 37-47
7. **Anagnostopoulos A.,** Foged N., de Quelerij L.: "Laboratory method for determination of water content of soils". Standarisation of Laboratory Testing, Danish Geotechnical Society Publ., Copenhagen, 1995, pp 5-8
8. **Anagnostopoulos A.,** Foged N., de Quelerij L.: "Laboratory determination of density of cohesive soils". Standarisation of Laboratory Testing, Danish Geotechnical Society Publ., Copenhagen, 1995, pp 9-14
9. Atkison J., **Anagnostopoulos A.,** Clayton C, Bonnechere P., Head K: "Incremental loading oedometer test on water-saturated soil". Standarisation of Laboratory Testing, Danish Geotechnical Society Publ., Copenhagen, 1995, pp 45-61
10. **Anagnostopoulos A.:** "Foundation improvement: underpinning of monuments; methods and experience". The Conservation Project: knowledge of the functional elements for the planning of interventions and geotechnical aspects of the protection. C.U.M. University School of Monument Conservation. 3rd Course. Gargano-Limone sul Garda 1995 – pp. 187-202.

Δ. Διδακτικά Συγγράμματα – Σημειώσεις

Συγγράμματα

1. **Αναγνωστόπουλος Α.**: Βαθειές Θεμελιώσεις δια Πασσάλων. Εκδόσεις Συμεών, 1990, σελ. 190
2. **Αναγνωστόπουλος Α.,** Χριστούλας Στ., Παπαδόπουλος Β.: Διαστασιολόγηση Θεμελιώσεων σε Πασσάλους. Εκδόσεις Συμεών, 1992, σελ. 178
3. **Αναγνωστόπουλος Α.,** Παπαδόπουλος Β.: Επιφανειακές Θεμελιώσεις. Εκδόσεις Συμεών, 1989, επανέκδοση 2002, σελ. 320
4. Χριστούλας Στ. σε συνεργασία με **Αναγνωστόπουλο Α.:** Επιλογές Εφηρμοσμένης Γεωτεχνικής Μηχανικής. Εκδόσεις Συμεών, 1998, σελ. 217
5. **Αναγνωστόπουλος Α.,** Γεωργίου Π., Αναγνωστόπουλος Γ. (2014), "Εδαφικές Ιδιότητες από Επί-Τόπου Δοκιμές", Εκδόσεις ΣΥΜΕΩΝ, Αθήνα, σελ. 145
6. **Αναγνωστόπουλος Α.,** Παπαδόπουλος Β.: Σχεδιασμός των Θεμελιώσεων. Εκδόσεις Συμεών, 2016, σελ. 622

Διδακτικές Σημειώσεις

1. **Αναγνώριση - χαρακτηρισμός και ταξινόμηση των γεωδών εδαφών** (Σε συνεργασία με κ. Κ. Φιδετζή) Έκδοση της τ. Έδρας Θεμελιώσεων ΕΜΠ, 1967, σελ. 45
2. **Ευστάθεια Πρανών** (Σε συνεργασία με Σπ. Πηλίτση) Έκδοση της τ. Έδρας Θεμελιώσεων ΕΜΠ, 1974, σελ. 68
3. **Καθιζήσεις σε άργιλο** Δακτυλογραφημένες Σημειώσεις της τ. Έδρας Θεμελιώσεων ΕΜΠ, 1977, σελ.25
4. **Οριζόντια φορτία επί πασσάλων** (Σε συνεργασία με Β. Παπαδόπουλο) Δακτυλογραφημένες Σημειώσεις της τ. Έδρας Θεμελιώσεων ΕΜΠ, 1982, σελ.25
5. **Στοιχεία Αγκυρώσεων** Δακτυλογραφημένες Σημειώσεις του Τομέα Γεωτεχνικής ΕΜΠ, 1983, σελ. 27
6. **Αρχές και Εφαρμογές των Διαδρομών Τάσεων** Δακτυλογραφημένες Σημειώσεις του Τομέα Γεωτεχνικής ΕΜΠ, 1984, σελ. 25
7. **Αρχές Υπολογισμού των Καθιζήσεων** Έκδοση Τομέα Γεωτεχνικής, Εκδόσεις Συμεών, 1986, σελ. 72
8. **Ευστάθεια Γαιωδών και Βραχωδών Πρανών** (Σε συνεργασία με Β. Παπαδόπουλο) Σημειώσεις του Τομέα Γεωτεχνικής ΕΜΠ, για το 6° εξάμηνο Μ.Μ.Μ., 1987, σελ. 39
9. **Αβαθείς Θεμελιώσεις** (Σε συνεργασία με Β. Παπαδόπουλο) Σημειώσεις του Τομέα Γεωτεχνικής ΕΜΠ, 1987, σελ. 79
10. **Φέρουσα Ικανότης των Θεμελιώσεων** Δακτυλογραφημένες Σημειώσεις του Τομέα Γεωτεχνικής ΕΜΠ, 1987, σελ. 52
11. **Στοιχεία επί τόπου δοκιμών** Σημειώσεις για το ΔΠΜΣ «Σχεδιασμός και Κατασκευή Υπογείων Έργων», ΕΜΠ, 1998, σελ: 17
12. **Στοιχεία Αγκυρώσεων** Σημειώσεις για το ΔΠΜΣ «Σχεδιασμός και Κατασκευή Υπογείων Έργων», ΕΜΠ, 2000, σελ. 43
13. **Σημειώσεις Αντιστηρίξεων και Καθιζήσεων λόγω εκσκαφών** Δακτυλογραφημένες Σημειώσεις για το ΔΠΜΣ «Σχεδιασμός και Κατασκευή Υπογείων Έργων», ΕΜΠ, 2000, σελ.113. Επανέκδοση, συνεργασία κ. Η. Μιχάλη, 2004, σελ. 138

Ε. Συμμετοχή σε άλλες Εκδόσεις

1. Συμμετοχή στην Έκδοση: «Draft Model Eurocode 7: Common Unified Rules for Geotechnics, Design» (12 συγγραφείς) το οποίο συντάχθηκε για λογαριασμό των Ευρωπαϊκών Κοινοτήτων, από Επιτροπή μελών της International

Society for Soil Mechanics and Foundation Engineering, Βρυξέλλες, Δεκέμβριος 1987, σελ. 187

2. Πρακτικά Συνεδρίου: «Geotechnical Engineering of Hard Soils-Soft Rocks», Proceedings of an International Symposium Athens, 1993, volumes 1, 2 and 3. AA. Balkema Publishers. Editors A. Anagnostopoulos, Fr. Schlosser, N. Kalteziotis, R Frank
3. Συμμετοχή στην Έκδοση: «Recommendations of the ISSMGE for Geotechnical Laboratory Testing», Edited by L. de. Quelerij and M.R de Ruiter (15 συγγραφείς μέλη Επιτροπής ETC-5). An ISSMGE-DIN Publication, Beuth Verlag GmbH, Berlin-Wien-Zuerich, 1998, p 14
4. Πρακτικά Συνεδρίου: «Geotechnics of Hard Soils – Weak Rocks», Proceedings of the 15th European Conference on Soil Mechanics and Geotechnical Engineering, 2011, volumes 1, 2 and 3. AA. Balkema Publishers. Editors A. Anagnostopoulos, M. Pachakis, C. Tsatsanifos

ΣΤ. Συμμετοχή σε Συνέδρια – Συμπόσια - Ημερίδες

- International Symposium on Rock Mechanics (Madrid, October 1968)
- 2nd Congress of the International Society for Rock Mechanics (Beograd, September 1970)
- 5th European Conference on Soil Mechanics and Foundation Engineering (Madrid, April 1972)
- 8th International Conference on Soil Mechanics and Foundation Engineering (Moscow, August 1973)
- 1st European Symposium on Penetration Testing (Stockholm, June 1974)
- 6th European Conference on Soil Mechanics and Foundation Engineering (Wien, March 1976)
- 9th International Conference on Soil Mechanics and Foundation Engineering (Tokyo, July 1977)
- Συνέδριο Ζεύξης Ρίου-Αντιρρίου (Πάτρα, Σεπτέμβριος 1977)
- 7th European Conference on Soil Mechanics and Foundation Engineering (Brighton, September 1979)
- Ημερίδα Γεωτεχνικά Προβλήματα Αθηναϊκού Σχιστόλιθου (Αθήνα, Μάιος 1981)
- 10th International Conference on Soil Mechanics and Foundation Engineering (Stockholm, June 1981)
- 1η Ελληνική Ημερίδα Γεωτεχνικής (Αθήνα, Φεβρουάριος 1982)
- 2nd European Symposium on Penetration Testing (Amsterdam, May 1982)
- 8th European Conference on Soil Mechanics and Foundation Engineering (Helsinki, 1983)
- 2η Ελληνική Ημερίδα Γεωτεχνικής (Αθήνα, Ιούνιος 1985)
- Journées d'Etude ENPC: "La réglementation française et étrangère en géotechnique" (Paris, Décembre 1986)
- 9th European Conference on Soil Mechanics and Foundation Engineering (Dublin, August 1987)
- 1st International Geotechnical Seminar on Deep Foundations on Bored and Auger Piles (Ghent, June 1988)
- 1° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής (Αθήνα, 1988)
- International Symposium on "Engineering Geology as related to the study, preservation and protection of ancient works, monuments and historical sites" (Athens, September 1988)
- European Conference on Soil Mechanics and Foundation Engineering (Florence, May 1991)
- Journées d'Etude ENPC: "La pratique de la géotechnique dans Γ Europe des 12" (Paris, Juin 1992)
- 2° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής (Θεσσαλονίκη, Σεπτέμβριος 1992)
- 1st International Symposium on "Hard Soils-Soft Rocks" (Athens, September 1993)

- 11th European Conference on Soil Mechanics and Foundation Engineering (Copenhagen, May 1995)
- Bengt Broms Symposium on Geotechnical Engineering (Singapore, December 1995)
- 3° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής (Πάτρα, Μάρτιος 1997)
- The IAEG International Symposium on "Engineering Geology and the Environment" (Athens, June 1997)
- 14th International Conference on Soil Mechanics and Foundation Engineering (Hamburg, September 1997)
- Πανελλήνιο Συνέδριο των Τμημάτων Πολιτικών Μηχανικών (Θεσσαλονίκη, Μάιος 1997)
- 2nd International Symposium on "The Geotechnics of Hard Soils-Soft Rocks"* (Naples, October 1998)
- 12th European Conference on Soil Mechanics and Foundation Engineering* (Amsterdam, June 1999)
- Conference on "Avalanches-Landslides-Rock Falls-Debris Flows" (CALAR) (Wien, January 2000)
- 1st International Conference on "Geotechnical Engineering Education and Training" (Sinaia, June 2000)
- 4° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής (Αθήνα, Μάιος 2001)
- 15th International Conference on Soil Mechanics and Geotechnical Engineering (Istanbul, August 2001)
- 11th International Symposium on Deformation Measurements* (Santorini, May 2003)
- 13th European Conference on Soil Mechanics and Geotechnical Engineering* (Prague, August 2003)
- 1st International Conference on Advances in Mineral Resources Management and Environmental Geotechnology (Chania, June 2004)
- International Seminar on Geotechnics in Pavement and Railway Design and Construction (Athens, December 2004)
- 1st Greece-Japan Workshop, Seismic Design, Observation, Retrofit of Foundations (Athens, October 2005)
- 5° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής (Ξάνθη, Μάιος 2006)
- 14th European Conference on Soil Mechanics and Geotechnical Engineering (Madrid, September 2007)
- 1st International Conference on Education and Training in Geo-Engineering Sciences: Soil Mechanics and Geo-technical Engineering, Engineering Geology, Rock Mechanics. (Costanza, Romania, June 2008)

- 6° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής (Βόλος, Σεπτέμβριος 2010)
- 15th European Conference on Soil Mechanics and Geotechnical Engineering (Athens, September 2011)
- 7° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής (Αθήνα, Σεπτέμβριος 2014)
- 8° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής (Αθήνα, Νοέμβριος 2019)

Ζ. Μέλος Προεδρείων Συνεδρίων, Επιστημονικών Συμποσίων και Ημερίδων

1. 10° Παγκόσμιο Συνέδριο Εδαφομηχανικής και Θεμελιώσεων (ICSMFE), Στοκχόλμη, Ιούνιος 1981. Μέλος Προεδρείου της Συνεδρίας: Soil Exploration (με εισήγηση)
2. 2η Ελληνική Ημερίδα Γεωτεχνικής: «Παράμετροι Σχεδιασμού Θεμελιώσεων», Αθήνα, Ιούνιος 1985. Διοργάνωση: ΕΕΕΕΘ-ΕΜΠ. Γενικός Εισηγητής Συνεδρίας: Επιλογή παραμέτρων διατμητικής αντοχής
3. 1° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής, Αθήνα Φεβρουάριος 1988. Διοργάνωση: ΕΕΕΕΘ – ΕΜΠ. Γενικός Εισηγητής στη Συνεδρία: Θεμελιώσεις
4. The IAEG Intern. Symp. On "Engineering Geology as related to the study preservation and protection of ancient works, monuments and historical cities", Αθήνα, Σεπτέμβριος 1988. Διοργάνωση: IAEG
5. 2° Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής: Θεσσαλονίκη, Σεπτέμβριος 1992. Διοργάνωση: ΤΕΕ-ΕΕΕΕΘ. Πρόεδρος Συνεδρίας: Κανονισμοί Γεωτεχνικής (με εισήγηση)
6. 1st Intern. Symposium on Hard Soils - Soft Rocks, Αθήνα, Σεπτέμβριος 1993. Διοργάνωση: Ελληνική ΕΕΕΕΘ – Γαλλική ΕΕΕΕΘ Co-chairman Οργανωτικής Επιτροπής
7. The IAEG International Symposium on Engineering Geology and the Environment, Αθήνα, Ιούνιος 1997. Διοργάνωση: IAEG. Co-chairman Συνεδρίας: Natural and man-made hazards: Landslides, stability analysis, control, case histories
8. 14° Παγκόσμιο Συνέδριο Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ICSMGE) Αμβούργο, Σεπτέμβριος 1997. Μέλος Προεδρείου Συνεδρίας: Deep-in-place mixing methods including jet-grouting (με εισήγηση)
9. 2nd International Symposium on "The Geotechnics of Hard Soils - Soft Rocks", Νάπολη, Οκτώβριος 1998. Διοργάνωση: University of Napoli Π – Second University of Napoli. Chairman στη Συνεδρία: Introductory Reports (με εισήγηση)
10. Conference on "Avalanches - Landslides - Rock Falls – Debris Flows" (CALAR), Βιέννη, Ιανουάριος 2000. Διοργάνωση: Arsenal Research Institute (Austria) and the Swedish Geotechnical Institute. Co-chairman στη Συνεδρία: Landslides in Stiff Soils and Soft Rocks (με εισήγηση)
11. 4° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Αθήνα, Μάιος 2001. Διοργάνωση: ΤΕΕ-ΕΕΕΕΘ. Πρόεδρος Οργανωτικής Επιτροπής
12. 15° Παγκόσμιο Συνέδριο Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ICSMGE), Κωνσταντινούπολη, Αύγουστος 2001. Πρόεδρος Συνεδρίας: Design and performance of shallow foundations under static and dynamic loading
13. 1st International Conference on "Advances in Mineral Resources, Management and Environmental Geotechnology" Χανιά, Ιούνιος 2004. Co-chairman Συνεδρίας «Advances in Geotechnics and Geomechanics»
14. 5° Πανελλήνιο Συνέδριο Γεωτεχνικής και Γεωπεριβαλλοντικής Μηχανικής, Ξάνθη, Μάιος 2006. Διοργάνωση: ΤΕΕ-ΕΕΕΕΘ Πρόεδρος Οργανωτικής Επιτροπής
15. 15° Πανευρωπαϊκό Συνέδριο Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ECSMGE), Αθήνα, Σεπτέμβριος 2011. Πρόεδρος Οργανωτικής Επιτροπής

Η. Διαλέξεις

1. Guest Lectures in Soil Mechanics, Royal Institute of Technology, Stockholm, April 1981
   a. "The stress path method to predict settlements"
   b. "Deformation characteristics"
2. Journées d'Etude ENPC La réglementation française et étrangère en géotechnique, Paris, Décembre 1986
   a. La réglementation géotechnique en Grèce
   b. La réglementation géotechnique dans les autres pays de la CEE
3. Invite du Comité Français de la Mécanique des Sols et Fondations, Paris, Juin 1990
   "Roches tendres - sols indures"
4. Journées d'Etude ENPC La pratique de la géotechnique dans l'Europe des 12., Paris, Juin 1992
   a. "La situation en Grèce" étude
   b. "Les textes de référence"
5. 11th European Conference on Soil Mechanics and Foundation Engineering, Copenhagen, May 1995.
   Προσκεκλημένη ομιλία στα Workshops: a) Laboratory Testing b) Educational issues with attention to the professional and commercial implications
6. CUM. University School of Monument Conservation, Gargano - Limone sul Garda, September 1995
   "Foundation improvement: underpinning of monuments; methods and experience" (invited lecture)
7. Bengt Broms Symposium on Geotechnical Engineering, Singapore, December 1995
   "Restraint of an active landslide by bored piles" (invited lecture)
8. International Conference on Geotechnical Education and training, Sinaia, June 2000
   "Geotechnical engineering education in Greece" (invited lecture)
9. Ειδική Ομιλία στο 5ο Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής (Ξάνθη, 2006) με θέμα «Εδαφικές Μετακινήσεις από Εκσκαφές λόγω Υπογείων Έργων και Επιπτώσεις στις Κατασκευές»
10. 5η Αθηναϊκή Διάλεξη Γεωτεχνικής Μηχανικής με θέμα «Καθιζήσεις Επιφανειακών Θεμελιώσεων», Αθήνα 2008.
11. Ειδική Ομιλία στο 6ο Πανελλήνιο Συνέδριο Γεωτεχνικής Μηχανικής (Βόλος, 2010) με θέμα «Ευρωκώδικας 7 – Γεωτεχνικός Σχεδιασμός».
12. Προσκεκλημένη διάλεξη στο Geotechnical Symposium in Balkan Region (Τίρανα, Αλβανία, 2011) με θέμα «The Stability of Natural and Cut Slopes in Stiff Clays».

Επιπλέον, έχω δώσει σειρά διαλέξεων σε Ημερίδες και Σεμινάρια, ΤΕΕ, ΕΜΠ, ΕΕΕΕΘ, ΥΠΕΧΩΔΕ, ΤΕ Κύπρου κ. α. σε θέματα Επιλογής Τρόπου Θεμελιώσεως, Βαθειές Θεμελιώσεις, Επιλογής Εδαφικών Παραμέτρων, Επιτόπου Δοκιμών, Αρχών του Ευρωκώδικα 7, Διδασκαλία Γεωτεχνικής σε Π.Μ., κ.α.

Θ. Ερευνητικά Προγράμματα

Αναφέρονται ενδεικτικά Ερευνητικά Προγράμματα που εξεπόνησα σε συνεργασία με μέλη του Τομέα Γεωτεχνικής.

1. «Foundation design under cyclic loading for TLP's» (1991-1993) Sponsored: Jointly by the European Community and ADK Consultants Danish Geotechnical Institute, ADK Consultants, G. Bouckovalas, A. Anagnostopoulos
2. «Quality assurance in geotechnical testing» (1990-1994) Sponsored: by the European Community A. Anagnostopoulos, M. Kavvadas, P. Marinos
3. «Ευστάθεια περιφερειακών πρανών επιφανειακού ορυχείου στο Χωρέμι Μεγαλόπολης» (1991-1992) Χρηματοδότηση: ΔΕΗ. Α. Αναγνωστόπουλος Μ. Καββαδάς, Β. Πα-

παδόπουλος

4. «Μηχανική συμπεριφορά λιγνιτών Πτολεμαϊδας» (1991-1993) Χρηματοδότηση: ΔΕΗ. Μ. Καββαδάς, Α. Αναγνωστόπουλος
5. «Μικροζωνική ανάλυση Πύργου» (1993 -1994) Χρηματοδότηση: Νομαρχία Ηλείας. Γ. Μπουκοβάλας, Γ. Γκαζέτας, Α. Αναγνωστόπουλος, Π. Μαρίνος, Β. Παπαδόπουλος
6. «Διερεύνηση των συνθηκών ευστάθειας πρανών της γραμμής Πειραιώς-Πλατέως» (1993-1994) Χρηματοδότηση: Ο.Σ.Ε. Α. Αναγνωστόπουλος, Μ. Καββαδάς, Π. Μαρίνος
7. «Επιπτώσεις από τη διάνοιξη σήραγγας κάτω από το Κάστρο Πλαταμώνα» (1993) Χρηματοδότηση: Ο.Σ.Ε. Α. Αναγνωστόπουλος Β. Παπαδόπουλος
8. «Βελτίωση λειτουργιών Λιμένος Ζακύνθου (1994-1995)» Χρηματοδότηση: Λ.Τ. Ζακύνθου. Μ. Καββαδάς, Α. Αναγνωστόπουλος ως Συνεργάτες του Εργαστηρίου Λιμενικών Έργων
9. «Διερεύνηση των συνθηκών ευστάθειας τελικών πρανών εκσκαφής των ορυχείων Χωρεμίου και Κυπαρισσιών» (1995-1998) Χρηματοδότηση: ΔΕΗ. Α. Αναγνωστόπουλος, Μ. Καββαδάς
10. «Επίπτωση εκρήξεων στον αγωγό φυσικού αερίου» (1995-1996) Χρηματοδότηση: ΔΕΠΑΑ.Ε. Γ. Μπουκοβάλας, Α. Αναγνωστόπουλος ως Συνεργάτες των Καθηγητών Ν. Μαρκάτου, Α. Κανάραχου
11. «Συνθήκες θεμελίωσης για τον Νέο Λιμένα Ηγουμενίτσας» (1996-1998) Χρηματοδότηση: ΥΠΕΧΩΔΕ. Α. Αναγνωστόπουλος, Β. Παπαδόπουλος
12. «Αξιολόγηση γεωτεχνικών και σεισμολογικών επιδράσεων για την κατασκευή υποθαλάσσιου αγωγού διάθεσης λυμάτων Ε.Ε.Λ. Πατρών» (1997-1998) Χρηματοδότηση: Δ.Ε.-Υ.Α.Π. –Πατρών. Α. Αναγνωστόπουλος, Β. Παπαδόπουλος, Γ. Μπουκοβάλας
13. «Διορθωτικά μέτρα για τη σιδηροδρομική σήραγγα Μεθώνης» (1997-1998) Χρηματοδότηση: Ο.Σ.Ε. Π. Μαρίνος Μ. Καββαδάς, Α. Αναγνωστόπουλος
14. «Γεωπρόοδος» (1998-2001) Χρηματοδότηση: Γ.Γ.Ε.Τ. Π. Μαρίνος, Γ. Τσιαμπάος, Α Αναγνωστόπουλος κ. α.
15. «Διερεύνηση συνθηκών ευστάθειας ανατολικού μόνιμου πρανούς του ορυχείου Κυπαρρισίων» (2000-2001) Χρηματοδότηση: ΔΕΗ. Μ. Καββαδάς Α Αναγνωστόπουλος
16. «Αντισεισμική Προστασία Δήμου Άνω Λιοσίων: Γεωτεχνικές συνθήκες θεμελιώσεως» (2000) Χρηματοδότηση: Δήμος Άνω Λιοσίων. Γ. Μπουκοβάλας, Α. Αναγνωστόπουλος, Β. Παπαδόπουλος
17. «Ανάπτυξη συστήματος επιτόπου αξιολόγησης συμπεριφοράς εδαφών, οδοστρωμάτων και δαπέδων» (2000-2003) Χρηματοδότηση: ΕΜΠ/ΕΛΕ. Α. Λοϊζος, Α. Αναγνωστόπουλος
18. «Διερεύνηση μηχανικής συμπεριφοράς του φράγματος Μόρνου» (2001-2003) Χρηματοδότηση: Ε.Υ.Δ.Α.Π. Μ. Καββαδάς, Π. Μαρίνος, Α. Αναγνωστόπουλος
19. «Γεωλογική-γεωτεχνική έρευνα και διατύπωση μέτρων στερέωσης υψηλών βραχωδών πρανών και υπερκείμενων τειχών Κάστρων και προστασία υποκείμενων ιστορικών μνημείων στο κάστρο Μονεμβασιάς» (2003-2005) Χρηματοδότηση: Υπουργείο Πολιτισμού. Π. Μαρίνος Γ. Τσιαμπάος, Μ. Καββαδάς, Α. Αναγνωστόπουλος κ.α.

Επετειακός Τόμος Τομέα Γεωτεχνικής Σχολής Πολιτικών Μηχανικών Ε.Μ. Πολυτεχνείου για τον Ανδρέα Αναγνωστόπουλο

Τον Ιούνιο 2015 ο Τομέας Γεωτεχνικής εξέδωσε επετειακό το προς τιμή του Ανδρέα Αναγνωστόπουλου. Στην συνέχεια παρατίθενται κάποια κείμενα από τον τόμο αυτό.

ΠΡΟΛΕΓΟΜΕΝΑ

Με μεγάλη χαρά δράττομαι της ευκαιρίας να προλογίσω τον Επετειακό Τόμο που εκδίδει ο Τομέας Γεωτεχνικής της Σχολής Πολιτικών Μηχανικών Ε.Μ. Πολυτεχνείου για τον επί πολλά έτη Καθηγητή και σήμερα Ομότιμο Καθηγητή ΕΜΠ Ανδρέα Αναγνωστόπουλο.

Γνώρισα τον Ανδρέα Αναγνωστόπουλο το 1975-76, κατά την φοίτησή μου στην Σχολή Πολιτικών Μηχανικών ΕΜΠ, οπότε ο Ανδρέας, τότε νεαρός Διδάκτωρ και Επιμελητής στην Έδρα Θεμελιώσεων, με εισήγαγε στις έννοιες της Εδαφομηχανικής που εκείνη την εποχή ήταν πρωτοποριακές στην Ελλάδα. Γοητεύθηκα σε τέτοιο βαθμό, ώστε τελικώς να ασχοληθώ δια βίου με την Εδαφομηχανική.

Μετά τον διορισμό μου στο ΕΜΠ ως Λέκτορα το 1987, συνεργάσθηκα με τον Ανδρέα, ως συνάδελφος πλέον, τόσο σε διδακτικά όσο και σε ερευνητικά θέματα, και η εξαιρετική μας συνεργασία συνεχίζεται μέχρι σήμερα. Μέχρι το 2004 (που συνταξιοδοτήθηκε), ο Ανδρέας ήταν η «ψυχή» του Τομέα για όλα τα μέλη του: πάντοτε παρών και πρόθυμος στα διοικητικά θέματα (τα οποία όλοι οι υπόλοιποι αποφεύγαμε, θεωρώντας τα ως «αγγαρεία»), ο Ανδρέας φρόντιζε για όλα: από την διάθεση των πιστώσεων για την ανάπτυξη του Τομέα, μέχρι την διάθεση γραφείων στο κτίριο Γκίνη για τα μέλη ΔΕΠ, και βεβαίως την μεταστέγαση του Τομέα Γεωτεχνικής στα Νέα Κτίρια Πολιτικών Μηχανικών στην Πολυτεχνειούπολη Ζωγράφου το 2002. Ειδικά για το τελευταίο, νομίζω ότι όλοι στον Τομέα του οφείλουμε αμέριστη ευγνωμοσύνη, καθώς ο Ανδρέας είχε αναλάβει την αποκλειστική διαχείριση του θέματος τόσο σε τεχνικό επίπεδο (ως πρόεδρος της Επιτροπής του σχετικού Αρχιτεκτονικού Διαγωνισμού και μέλος της Επιτροπής Επίβλεψης της κατασκευής) όσο και σε διοικητικό επίπεδο (π.χ. την κατανομή των γραφείων στα μέλη του Τομέα – όχι και τόσο εύκολο για προφανείς λόγους, τα ευμεγέθη γραφεία και άνετα εργαστήρια στο Νέο Κτίριο που οφείλονται αποκλειστικά στις άοκνες προσπάθειες του Ανδρέα να παρακάμψει τις όποιες αντιρρήσεις της Τεχνικής Υπηρεσίας, κλπ). Πάντα με ευχάριστη διάθεση, χιούμορ, διαλλακτικότητα, αλλά και ενίοτε με την γνωστή καυστική του ειρωνεία (όταν δεν τα κατάφερνε αλλιώς), ο Ανδρέας πετύχαινε να συγκεράζει τις διαφορετικές (και συχνά παράλογες) απόψεις όλων μας και να βρίσκει σημεία συμφωνίας ώστε να λύνονται τα προβλήματα και να είναι όλοι κατά το δυνατόν ευχαριστημένοι. Ομολογώ ότι στα διοικητικά θέματα και τις αρμοδιότητές μου ως Διευθυντή του Τομέα Γεωτεχνικής, το παράδειγμα του Ανδρέα με εμπνέει και καθοδηγεί καθημερινά.

Ένα άλλο σπάνιο χαρακτηριστικό του Ανδρέα είναι η αμέριστη προθυμία του στην προώθηση των νεότερων συναδέλφων και συνεργατών του στα θέματα όπου αυτός, ως παλαιότερος, είχε συμμετοχή ή του ζητούσαν συμμετοχή. Σ' αυτόν τον τομέα, του οφείλω πάρα πολλά επίσης, όπως (ενδεικτικά): η συμμετοχή μου από το 1991 στην Ομάδα Σύνταξης του Ευρωκώδικα 7 (όπου είχα την ευκαιρία να συνεργασθώ με τους διαπρεπέστερους ευρωπαίους συναδέλφους), η ενασχόλησή μου με τις μηχανικές ιδιότητες των σκληρών εδαφών (μέσω της επιμονής του να αναπτύξω εργαστηριακές διατάξεις στο Εργαστήριο Θεμελιώσεων για την διερεύνηση της μηχανικής συμπεριφοράς των μαργών, την προώθησή μου στην ΔΕΗ για θέματα ευστάθειας πρανών των λιγνιτωρυχείων, και την οργάνωση από τον Ανδρέα δύο διεθνών συνεδρίων στο θέμα αυτό, το 1993 και το 2011) αλλά και σε θέματα σηράγγων όπου το 1997-98 ο Ανδρέας συμμετείχε στην οργάνωση του Μεταπτυχιακού Προγράμματος «Σχεδιασμός και Κατασκευή Υπογείων Έργων». Έτσι, λίγο-πολύ «υποχρέωσε» αρκετά από τα μέλη του Τομέα να ασχοληθούν με θέματα σηράγγων, δίνοντάς μας την δυνατότητα και την μεγάλη ευκαιρία να βρεθούμε στην αιχμή της τεχνολογίας των σηράγγων κατά την «μπονάντσα» της πρώτης δεκαετίας του 2000. Τέλος, σε θέματα διδασκαλίας, ποτέ δεν δίστασε να προωθήσει τους νεότερους συναδέλφους ακόμη και σε θέματα που παραδοσιακά αποτελούσαν το γνωστικό του αντικείμενο (όπως οι Επιφανειακές και Βαθιές Θεμελιώσεις). Γενικώς, νομίζω ότι ο Τομέας Γεωτεχνικής οφεί-

λει πάρα πολλά στον Ανδρέα για την εξαιρετική συνεργασία μεταξύ των μελών και την απρόσκοπτη διαδοχή των διδασκόντων στο εκπαιδευτικό έργο λόγω των χωρίς αντικατάσταση συνταξιοδοτήσεων τα τελευταία έτη.

Πέραν των ανωτέρω, η επί 50 συναπτά έτη προσφορά του Ανδρέα Αναγνωστόπουλου στον Τομέα Γεωτεχνικής, αλλά και στο Ε.Μ. Πολυτεχνείο. υπήρξε καταλυτική. Σταχυολογώντας κάποιες από τις πολλές δραστηριότητές του θα αναφέρω: την εξ αρχής διαμόρφωση της διδασκαλίας αρκετών προπτυχιακών αλλά και μεταπτυχιακών γεωτεχνικών μαθημάτων και την συγγραφή των διδακτικών βιβλίων και σημειώσεων, την οργάνωση και εξοπλισμό του Εργαστηρίου Θεμελιώσεων του οποίου διετέλεσε Διευθυντής επί αρκετές δεκαετίες, την ουσιαστική συμβολή του στην Εισαγωγή της Κατεύθυνσης Γεωτεχνικού Μηχανικού στο πρόγραμμα των Πολιτικών Μηχανικών το 2002, την οργάνωση της μεταφοράς του Τομέα Γεωτεχνικής στα Νέα Κτίρια Ζωγράφου το 2002, και βεβαίως την πολυετή θητεία του ως Διευθυντής του Τομέα Γεωτεχνικής και ως Αναπληρωτής Πρόεδρος του Τμήματος Πολιτικών Μηχανικών και τελικά ως Πρόεδρος του Τμήματος Πολιτικών Μηχανικών κατά την διετία 2001-03.

Τέλος, ο Ανδρέας Αναγνωστόπουλος ήταν και είναι πολύ αγαπητός στους συναδέλφους του και εκτός ΕΜΠ, τόσο στην Ελλάδα όσο και στο Εξωτερικό, απόδειξη της οποίας αποτελεί η αθρόα προσφορά και συνεισφορά άρθρων από τους εκλεκτούς συναδέλφους στον παρόντα Επετειακό Τόμο. Έτσι, η τιμητική αυτή έκδοση αποτελεί ένα ελάχιστο δείγμα εκτίμησης από τους συναδέλφους και συνεργάτες του, της οποίας ο Ανδρέας είναι απολύτως άξιος.

Ανδρέα σε ευχαριστούμε…

Αθήνα, Ιούνιος 2015

ΜΙΧΑΛΗΣ ΚΑΒΒΑΔΑΣ
Αναπλ. Καθηγητής ΕΜΠ
Διευθυντής του Τομέα Γεωτεχνικής ΕΜΠ
Υπεύθυνος Έκδοσης Επετειακού Τόμου

ΠΡΟΛΟΓΟΣ ΤΟΥ ΚΟΣΜΗΤΟΡΑ ΤΗΣ ΣΧΟΛΗΣ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ ΕΜΠ

Εκ μέρους της Σχολής Πολιτικών Μηχανικών του ΕΜΠ χαιρετίζω την έκδοση αυτού του τόμου προς τιμήν του Ομότιμου Καθηγητή της Σχολής Ανδρέα Αναγνωστόπουλου και ευχαριστώ για τη συμβολή τους τα επίλεκτα μέλη της Σχολής, του τεχνικού κόσμου της χώρας και της παγκόσμιας επιστημονικής και τεχνολογικής κοινότητας.

Το πολυσχιδές διδακτικό έργο και το σημαντικότατο διοικητικό έργο του Ανδρέα Αναγνωστόπουλου σημάδεψε μια μεγάλη περίοδο της ιστορίας της Σχολής, σχεδόν 40 χρόνια ξεκινώντας από το 1964. Το επιστημονικό και ερευνητικό έργο του στη διερεύνηση της συμπεριφοράς των εδαφών, στις θεμελιώσεις και στην εφαρμοσμένη γεωτεχνική συνεχίζεται και μετά την αποχώρησή του από την ενεργό υπηρεσία το 2004. Η συνεχής και έντονη παρουσία του στη Σχολή, η εργατικότητα και η αφοσίωσή του είναι παροιμιώδεις. Η συμβολή του στη δημιουργία του Τομέα Γεωτεχνικής, τον οποίο και διεύθυνε επί εξαετία και στη συνέχεια στην καθιέρωση της Κατεύθυνσης Γεωτεχνικού Μηχανικού, ήταν καθοριστική.

Η Σχολή τού εμπιστεύθηκε την ηγεσία της, στους ρόλους του Αναπληρωτή Προέδρου (1993-2001) και του Προέδρου της (2001-2003). Τους τίμησε με τον καλύτερο τρόπο. Στη διάρκεια της θητείας του, η Σχολή έκανε το σημαντικό βήμα της μετάβασης από το ιστορικό συγκρότημα στο κέντρο της Αθήνας και το κτήριο Γκίνη στις νέες της εγκαταστάσεις και τα νέα διδακτήρια στην Πολυτεχνειούπολη Ζωγράφου. Στον χώρο των διεθνών συνεργασιών, καθοριστική ήταν η πρωτοβουλία του για τη στρατηγική συμφωνία συνεργασίας της Σχολής μας με την École Nationale des Ponts et Chaussées του Παρισιού, συμφωνία που και σήμερα αξιοποιούν φοιτητές μας παρακολουθώντας μαθήματα και από τις δύο Σχολές και επιτυγχάνοντας διπλό δίπλωμα.

Η πολιτεία του ως Προέδρου χαρακτηρίστηκε από δημοκρατικότητα και δικαιοσύνη. Σε μια περίεργη εποχή, όπου τέτοιες αξίες είχαν αντικατασταθεί από αντίστοιχες «ταμπέλες» που αποδίδονταν από διάφορους μηχανισμούς, εκείνος τις κατέκτησε έμπρακτα με τη συμπεριφορά του και τη δουλειά του. Έχω προσωπική εμπειρία για το πώς βοηθούσε να απεμπλακούν υποθέσεις που είχαν παγιδευτεί από μηχανισμούς είτε αυτές αφορούσαν την προώθηση διαδικασιών έρευνας είτε την αξιοκρατική εξέλιξη καθηγητικού προσωπικού.

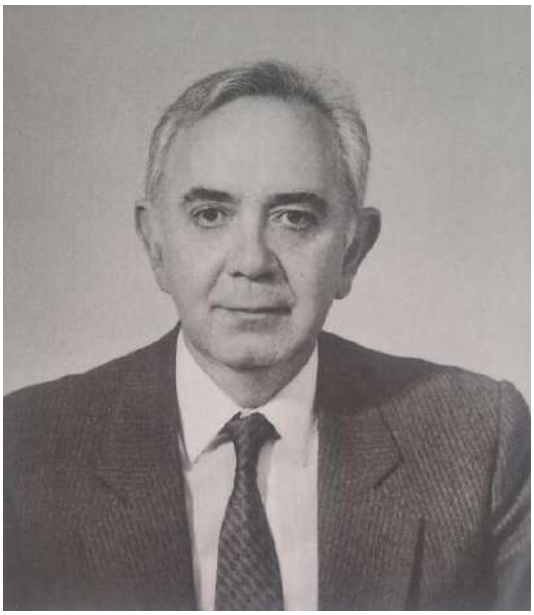
Στην κοινωνική προσφορά του εκτός του Ιδρύματος συγκαταλέγονται η πολύχρονη συμμετοχή και δραστηριότητά του σε Οργανισμούς δημόσιου ενδιαφέροντος, σε επιστημονικές επιτροπές και σε ελληνικές και διεθνείς επιστημονικές οργανώσεις. Παράλληλα προσέφερε υπηρεσίες συμβούλου για τεχνολογικά έργα.

Αν θα ξεχώριζα κάτι από τον χαρακτήρα του για να το προβάλλω ως υπόδειγμα για όλους μας, πανεπιστημιακούς δασκάλους και επαγγελματίες μηχανικούς, αυτό θα ήταν το χάρισμα του χιούμορ. Όχι μόνο γιατί κάνει τη ζωή μας πιο ευχάριστη, αλλά γιατί κάνει την επικοινωνία και ιδιαίτερα τη διδασκαλία αποτελεσματικότερη. Τον μέμφομαι όμως που ως Πρόεδρος δεν θεσμοθέτησε την αίσθηση χιούμορ ως απαραίτητο προσόν για την εκλογή καθηγητικού προσωπικού στη Σχολή.

Παρά την παράλειψη αυτή, η Σχολή μας κατακτά σημαντικές διακρίσεις στην Ελλάδα και παγκοσμίως. Το οφείλει μεταξύ άλλων στη δουλειά αφοσιωμένων δασκάλων όπως ο Ανδρέας Αναγνωστόπουλος. Τον ευχαριστώ θερμά για τις υπηρεσίες του στη Σχολή, εκπαιδευτικές, επιστημονικές και διοικητικές.

Αθήνα, Ιούνιος 2015

Καθηγητής ΔΗΜΗΤΡΗΣ ΚΟΥΤΣΟΓΙΑΝΝΗΣ
Κοσμήτορας Σχολής Πολιτικών Μηχανικών ΕΜΠ



Ο Ανδρέας Αναγνωστόπουλος έφυγε στις 4 Απριλίου 2025. **Καλό ταξίδι φίλε!**

ΑΡΘΡΑ

Selection of Optimal Intensity Measures and Seismic Fragility Analysis of Prefabricated Rectangular Subway Stations

Miaojun Qin, Yong Guo , Feng Shi , Yan-Gang Zhao and Xiaobin Wang

Abstract

Seismic risk assessment is pivotal for ensuring the reliability of prefabricated subway stations, where selecting optimal intensity measures (IMs) critically enhances probabilistic seismic demand models and fragility analysis. While peak ground acceleration (PGA) is widely adopted for above-ground structures, its suitability for underground systems remains debated due to distinct dynamic behaviors. This study identifies the most appropriate IMs for soft soil-embedded prefabricated subway stations at varying depths through nonlinear finite element modeling and develops corresponding fragility curves. A soil–structure interaction model was developed to systematically compare seismic responses of shallow-buried, medium-buried, and deep-buried stations under diverse intensities. Incremental dynamic analysis was employed to construct probabilistic demand models, while candidate IMs (PGA, PGV, and v_{rms}) were evaluated using a multi-criteria framework assessing correlation, efficiency, practicality, and proficiency. The results demonstrate that burial depth significantly influences IM se-lection: PGA performs optimally for shallow depths, peak ground velocity (PGV) excels for medium depths, and root mean square velocity (v_{rms}) proves most effective for deep-buried stations. Based on these optimized IMs, seismic fragility curves were generated, quantifying damage probability characteristics across burial conditions. The study provides a transferable IM selection methodology, advancing seismic risk assessment accuracy for prefabricated underground infrastructure. Through a systematic investigation of the correlation between IM applicability and burial depth, coupled with the development of fragility relationships, this study establishes a robust technical framework for enhancing the seismic performance of subway stations, and provides valuable insights for seismic risk assessment methodologies in underground infrastructure systems.

1. Introduction

The construction of cast-in-situ concrete structures presents multiple technical challenges during the implementation phase, characterized by high process complexity, prolonged construction periods, significant susceptibility to climatic conditions, considerable challenges in structural crack control, and heightened reliance on manual labor. To address the above-mentioned issues and achieve the sustainable development of the ecological environment, prefabricated buildings, with their characteristics of shorter construction periods, high construction efficiency, energy conservation, and environmental friendliness, have witnessed widespread adoption in above-ground structures [1,2]. The advancement of prefabricated underground structures faces significant constraints, primarily stemming from the technical complexities involved in construction processes and the limitations of practical construction conditions, resulting in their current application being largely confined to tunnels with standardized shapes and modest cross-sectional sizes [3,4]. Meanwhile, research and application of prefabricated modular structures have begun in large-scale underground structures, including subway station complexes [5]. As early as the 1960s, prefabricated modular structures were introduced into the construction of underground engineering, such as in the concrete structural lining and tunnel construction of the Rotterdam station in The Netherlands [6], the Olympic station and Minsk station in Russia [7], the Xing Plaza subway station in France [8], the Sendai subway station in Japan, etc. [9].

In alignment with the national strategic objectives of carbon peak and carbon neutrality, China's construction sector is undergoing a progressive transition towards industrialization, with a particular emphasis on fostering sustainable development and environmental protection. This paradigm shift represents a concerted effort to facilitate the industry's green transformation, thereby contributing to the realization of dual carbon targets through the systematic implementation of industrialized construction practices. In recent years, prefabricated subway stations have witnessed rapid development in urban rail transit, such as Yuanjiadian Station on Line 2 in Changchun [5], Jinshuiqiao Station on Line 6 in Beijing [10], Wuzhong Road Station on Line 15 in Shanghai, and Longxi Station on Line 16 in Shenzhen [11,12]. Generally, underground structures experience significantly less damage under seismic actions compared to above-ground structures [13, 14]. However, subway stations and tunnels still sustain damage in earthquake events, such as in the 2008 Wenchuan earthquake and the 2023 earthquake in Turkey's Kahramanmaraş province.

The seismic resilience assessment of underground infrastructure, particularly subway stations in metropolitan areas, remains a critical research focus in structural engineering due to its substantial implications for public safety and urban functionality [15]. These subsurface transportation hubs, predominantly situated in densely populated urban centers within seismically vulnerable zones [16], pose unique engineering challenges during post-earthquake rehabilitation and reconstruction processes. The complexity of these challenges arises from the intricate interplay among structural integrity, geological conditions, and urban environmental constraints, making seismic performance evaluation an essential component of modern underground structural design and maintenance protocols.

Seismic safety risk assessment serves as an important basis for structural evaluation reliability. Seismic fragility analysis stands as a pivotal approach for the quantitative assessment of structural seismic risk [17]. The seismic demand model serves as the crucial bridge connecting seismic hazards with structural response behavior, forming an essential part of the seismic fragility analysis framework [18].

A seismic demand model refers to the conditional probability that the specific demand of the subway station structure or component is equal to or exceeds a specific value at the given intensity measure (IM) of seismic excitation. Previous studies have shown that accurate probabilistic seismic demand models and seismic fragility mainly rely on appropriate IMs [19]. IM serves as the process variable linking seismic hazards and structural demand models. An appropriate IM can not only reflect the main parameters of earthquake, especially magnitude and spectrum, but is also able fully consider the randomness of seismic excitation, thereby achieving the goal of accurately predicting structural responses [20].

Recently, researchers have proposed various fragility curves under different conditions for different structures [21], including slope and tunnel structures. Pejovic et al. [22] suggested using IMs that include spectral features or velocity related types for the seismic demand model in high-rise frame structures. For example, by using numerical calculations, detailed research has been conducted on tunnels [23,24]. However, most fragility curves are constructed based on various intensity indicators selected by empirical judgment. For instance, peak ground acceleration (PGA), cumulative absolute velocity (CAV), acceleration spectrum intensity (ASI), etc., are used as IMs in the seismic fragility analysis of tunnel and subway stations structures [25,26]. Meanwhile, Huang et al.

considered critical elements impacting the dynamic characteristics of tunnels, such as site condition and burial depth, in the numerical analysis [23]. The study reveals that PGA is the most appropriate IM for shallow-buried conditions, whereas peak ground velocity (PGV) proves to be the optimal IM for medium–deep and deep-buried conditions. Hu [27] studied the effect of burial depth on the seismic fragility of subway tunnels, and their findings indicate that the failure probability of tunnels does not exhibit a monotonic decrease as burial depth increases. In their study aimed at identifying the optimal IM for subway stations, Zhang et al. conducted a comprehensive analysis that concurrently considered both site conditions and burial depth factors. Their results indicate that the pseudo-spectral velocity (PSV) and PGV represent the most effective IMs for burial depth of 4 m [28]. In summary, the burial depth constitutes a critical parameter that significantly influences the predictive accuracy of the probabilistic seismic demand model (PSDM). Current research exhibits significant limitations regarding two critical aspects: (1) the identification of appropriate IMs for the PSDM of prefabricated subway stations across varying burial depths, and (2) the understanding of the fundamental mechanisms through which burial depth influences PSDM performance. Therefore, a systematic investigation into the influence of burial depth on the appropriate IM for the PSDM of a prefabricated subway station represents a crucial research direction.

In view of this, the present study establishes a comprehensive numerical investigation framework, utilizing a three-story, two-span subway station from a specific site as the prototype. The 2D finite element model was established using ABAQUS, which can reflect detailed soil–structure interaction characteristics to analyze the seismic performance of prefabricated rectangular subway stations with various burial depths. This research systematically examines how different burial depths affect the seismic response characteristics of prefabricated rectangular subway stations, with particular focus on three critical aspects: (1) inter-story drift ratios, (2) internal force distributions in the structure, and (3) seismic damage patterns and their progression. Simultaneously, a comprehensive evaluation of 19 widely used IMs was conducted based on four rigorous selection criteria: efficiency, practicality, proficiency, and sufficiency. A flowchart of this study is depicted in Figure 1.

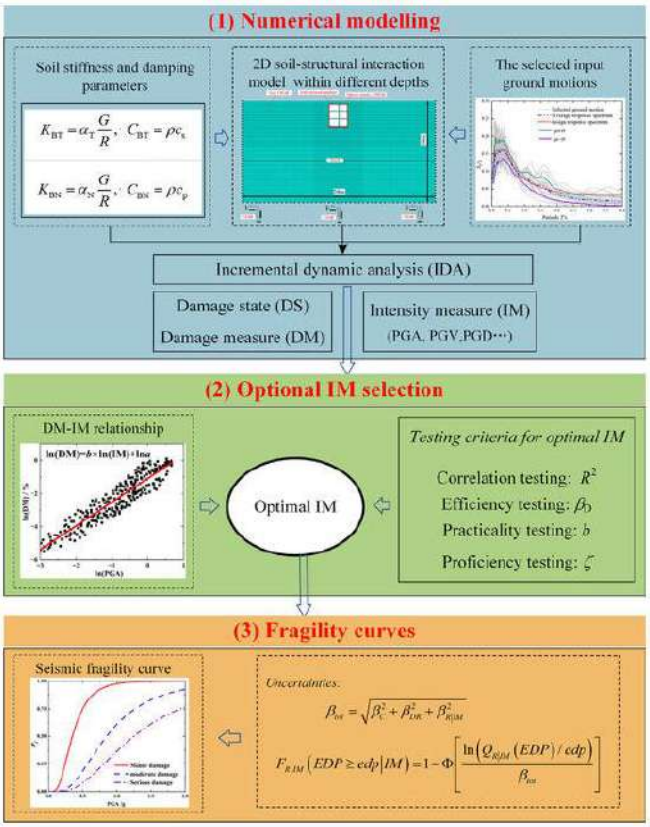


Figure 1. Seismic fragility analysis process for prefabricated rectangular subway stations.

2. Seismic Fragility Analysis and Seismic IM Evaluation

2.1. Seismic Fragility Analysis Theory

The seismic fragility curve serves as a probabilistic representation of structural vulnerability, quantifying the conditional probability of a structural system attaining or surpassing predefined damage states across varying seismic intensity measures. The mathematical formulation for seismic fragility assessment can be expressed through the following Equation (1), which establishes the relationship between ground motion intensity parameters and structural damage probability distributions [29].

….

(MPDI, Published: 10 April 2025,
https://www.mdpi.com/2073-8994/17/4/580)

Is sand becoming scarce?

Tommer Vermaas

"Sand is the most important and widely used resource after water!" reveals Tommer Vermaas who is a Coastal Geologist at Deltares. In fact, in some places in the world, there is already a shortage. Why is that and do we still have enough supply in the Netherlands? To properly map the sand situation in our own country, Deltares is developing an improved model together with TNO – Geological Survey of the Netherlands on request of Rijkswaterstaat to calculate our sand supply on the seabed.

Seismic sand model

Sand is used for many different purposes such as for our coastal defense, but also in construction as filler sand or to make concrete and in glass and electronics. *Sand expert* Tommer Vermaas knows all about it. As chief project manager of the Aggregates Information System, he accurately maps our Dutch sand reserves at sea.

Tommer: "We are working on an improvement of the earlier model where we are now adding another source of information: seismic data. Whereas a borehole gives information at a single point, seismic data gives it along a line. It is measured from a ship, and along the entire sailing line you get a 2D image of the subsurface. This gives us a more detailed picture of the sand layers under the seabed. Before, only drilling was used."

"I like putting the puzzle of the subsoil together and want to solve practical issues. These range from wind turbines we want to build at sea, dike safety and also sand. As a coastal geologist, I mainly study coastal development and how everything is preserved in the subsoil."

3D Model

If in the Netherlands we don't consider the availability of sand in our spatial planning, we will run into problems in the long run. Cables or wind farms, for example, might then be in the way for sand extraction. Then it becomes much more expensive to extract suitable sand. It is important to keep enough sand available for our coastal defenses and construction in the long term.

Together with TNO - Geological Survey of the Netherlands, we are making a new subsurface model of the sand mining area in the North Sea on behalf of Rijkswaterstaat. We are now using detailed 3D modelling in it to map where each type of sand is located.

This also allows us to calculate how much sand there is. As manager of the North Sea, Rijkswaterstaat also uses this model when granting permits or planning cable routes or wind farms, for example.

> The extraction of sand is of national importance. Sand is necessary to keep coastal safety in order, and sand is also needed in construction. It is therefore very important that we have a good understanding of the sand reserves in the Netherlands.
>
> Quirijn Lodder, senior water safety advisor, Rijkswaterstaat

Serious sand shortage

"Here in the Netherlands, we still have enough sand, but in other places in the world it is scarce. Shortages are also not easy to solve because it is expensive to move sand over long distances," says Tommer.

"We have to keep an eye on our supplies for the long term. You must be able to access it and you need specific sand for different applications. If we lay a cable through the North Sea or build houses, we cannot remove the sand underneath. In IJmuiden, you can bring sand ashore easily because of the harbour. But the area where we can extract sand from the sea is limited by cables, pipelines, wind farms and a busy shipping route. Therefore, sand is scarce there anyway."

"It does not look like grains of sand may disappear altogether soon, but suitable sand cannot always be found nearby. Sometimes this makes it financially unattractive to extract that sand. Then there is scarcity after all. In the Netherlands, we don't have to worry yet when it comes to coastal defense sand, but we must keep it in mind."

Sand thieves

Globally, there is cause for alarm, Tommer points out. The sand issue received a lot of attention in 2022 due to a report by the United Nations Environment Programme UNEP. Helena van der Vegt, coastal researcher at Deltares, contributed to this. Among other things, this report warns of a shortage of construction sand in developing countries. This can lead to criminal practices, such as sand extraction from beaches without a permit.

Helena explains that there are different types of sand. "Construction sand should be angular and coarse (large grains), so that the grains hook firmly together. This sand is mainly found on the mainland in the Netherlands. Sand grains start out coarse and angular but gradually wear down and thus become finer (smaller grains) and rounder, as they continue to flow with the river and are blown by the wind."

Sometimes there is a lack of knowledge. Then sand is re-

moved somewhere, causing damage in other places. In Vietnam, for example, where sand was extracted from the Mekong River, which then no longer reaches the delta, resulting in flooding.

A borehole in which easily extractable sand can be seen: recent marine sands, with sand from the last ice age and marine sand from the last interglacial period below it.

Dune and desert sand cannot be used in construction because the sand grains are too fine and round. Thus, desert countries may have to import sand anyway.

Helena van der Vegt, coastal researcher Deltares

Sand status in the Netherlands

In the Netherlands, we have sand management under control, says Tommer. "Because of all our laws and regulations, we handle it responsibly in the Netherlands. We have also been nourishing our coasts with sand for 35 years."

Efforts are being made by UNEP to make all global data more transparent. Awareness and dialogue on sand have increased. There is also increasing attention to it in the media.

Tommer: "Another nice example is Vietnam, where several projects are ongoing and Deltares also provides sand supply advice. There, they are now more conscious about sand, both in rivers and at sea."

Sustainable sand management

Sand extraction from the North Sea requires extensive testing first, says Tommer. "Suppose we need two million cubic metres of sand for raising, selling or for construction. Then we first check where this is available and to what depth we need to go. We also study what sand there is and what the effects on ecology are if we take it out."

Tommer explains: "When we nourish the beach, we look for

sand similar to what is already there. We preferably don't have clay or stones on the beach. That's not good for ecology, nor is it nice for people enjoying the beach walking barefoot there. For our coastal defenses, we take sand further out to sea, where we expect no adverse effects on our beaches. Otherwise, you would be carrying water to the sea."

Drilling, vibrocores, as they are delivered from the ship to the lab. The 'downspouts' are cut in half lengthwise, after which the undisturbed subsoil becomes visible and can be analysed.

In sand extraction, you damage the seabed, taking away shells and other life. That is why an environmental impact assessment (EIA) study is carried out by a consultancy company. For the EIA Deltares specifically looks at the effects of sand extraction on ecology in the North Sea and the Wadden area. This mainly concerns fine material which is released when you extract sand from the sea floor. Those fines contain food for marine life, but too many fines also block light and can have adverse effects on the ecosystem.

Subsurface data shows what material has been deposited at the location of the datapoint. Using geological knowledge, you can then reconstruct the system that deposited that sediment. Once you understand that system, you can predict what you can expect at locations where there is no data. This way you can predict where you might encounter sand, how certain this prediction is and whether that sand is easily accessible.

Romée Kars, Geologist, TNO Geological Survey of the Netherlands

Alternatives to sand

Tommer says we need to look for solutions where you can build with less sand, such as other construction techniques, lighter building materials like wood and recycling of raw materials. "Because we have concrete houses that are heavy, we need to put a good layer of sand underneath to keep it stable. A lot of sand goes into the concrete itself, of course.

More drilling and seismic data

Tommer: "In the Netherlands, we are working with the Geological Survey and Rijkswaterstaat to further improve the model with new data." Abroad, there is still a lot to investigate and often little is known about sand availability. You

can't see what's under the ground with satellites, for that, drilling must be done, and seismic data must be available.

"We look at the cores from the North Sea in our lab in Delft", Tommer points out. "Every year boreholes are planned to get more insight into availability of our sand, and form input for the model we built. We then want to know how the sediment was deposited in the borehole. For example, did it come from rivers, sea or land ice? And how old is it? With that knowledge, we can better predict whether a clay layer occurs locally or over a larger area, and that gives more insight into the variation in sand composition. After all, a borehole is only a 10 cm wide, a few metres away the subsurface can be very different again."

What is your dream?

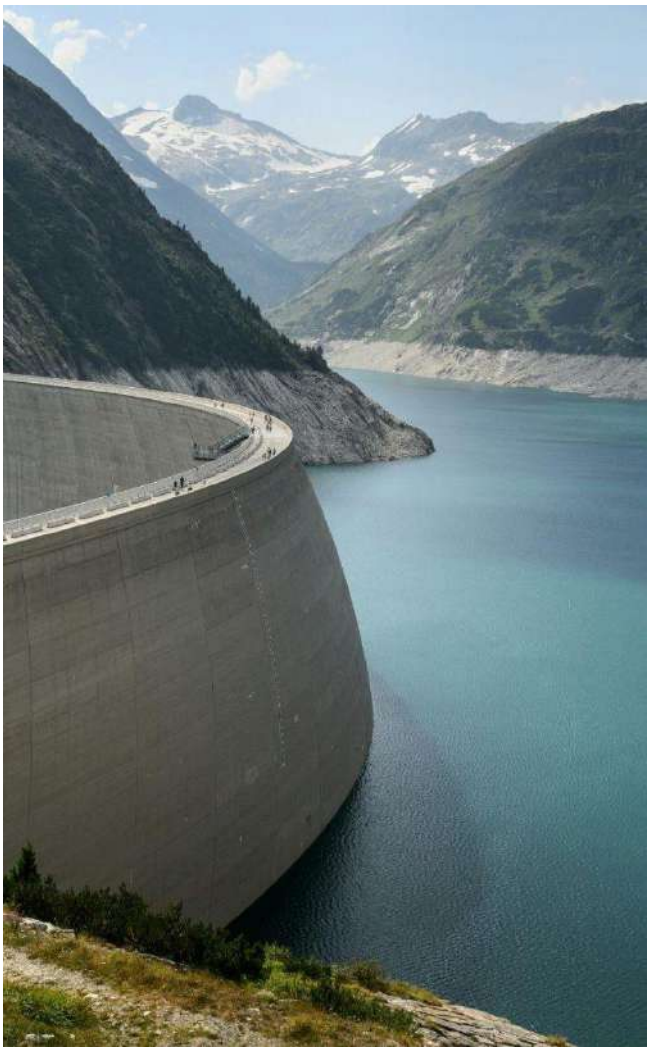
"I think it's incredibly beautiful that in the Netherlands we collect so much data and invest in properly mapping sand resources. As a geologist, that's a dream!"

(Deltares, 6 March 2025, https://www.deltares.nl/en/stories/is-sand-becoming-scarce)

A century of dam safety: Five key insights

Antonio Moreno Rodenas

Dams are essential for flood protection, water resources management, energy, and food security. However, their failure can lead to devastating consequences, as recent disasters have demonstrated. A new study, published in *Nature Water* by researchers from Deltares, IHE Delft, and Imperial College London, presents a detailed global analysis of dam failure probability from 1900 until present. This work unveils key factors behind the evolution of large dams' failures and offers insights into future trends.



Dam safety as a discipline emerged in the 20th century, integrating expertise from hydraulic, geotechnical and mechanical engineering, alongside statistical analysis. Driven by lessons from past failures, this approach has shaped modern dam design, construction, and risk management practices.

This research has applied for the first time a formal statistical survival modelling approach to the modern dam failure records, allowing the incorporation of new aspects of dam safety. This explicitly considers aspects like climatic regions, the dam owner's resources, age, and changes in construction efforts and trends. By reanalysing and updating the historical records from the International Commission on Large Dams on dam failures, this research provides a structured evaluation of dam failure probabilities at global scale.

Five new insights

The researchers identified five new insights with regards to long-term safety trends and the factors shaping contemporary dam safety. These insights are:

1. Sustained safety improvements over the 20th century

The probability of a large-dam failure has decreased consistently, with failure rates dropping by an average of 30% per decade since the early 1900s up to the end of the century. Dams built on a given epoch retain to a good extent the safety of those times, which might be linked to construction methods and design techniques of the time. Countries that experienced major dam failures have effectively "learnt" from those catastrophic experiences.

2. Early failures remain a critical factor

This old-known vulnerability remains, at least for embankment dams. Dams are more likely to fail during the first five years after construction than during the following 45-55 years. This study further highlights the temporal evolution of this early failure effect, which has strongly reduced, particularly for concrete dams.

3. No significant evidence of aging-related failures

While concerns about aging infrastructure are often raised, this research did not find a substantial increase in dam failures due to aging. Data shows that dams built at the beginning of the 20th century exhibit a clearly higher probability of failure, possibly linked to inherent outdated designs and construction practices, but this probability does not yet seem to accelerate over time.

4. A concerning reversal: rising failure rate of newly built dams

Since the 2000s, failure rates for newly built dams have increased for the first time in a century, reverting advances of the previous decades. This trend is linked to latest dam construction in low-income countries, especially where catastrophes have not been experienced before in the recent past.

5. Highest failure rate today linked to tropical zones and flooding

Highest failure rates of dams are currently observed in monsoon-tropical regions, especially in regions with lower purchasing power. While traditionally, structural, mechanical, and geotechnical failures have been relatively common, new failure statistics are increasingly dominated by flooding context. This research cannot attribute the recent surge in dam failure rates to climate change, but raises the need to conduct local specialised studies.

What makes a dam more prone to failure?

Dam safety is a complex matter, which requires very detailed knowledge on each structure's state, design and local characteristics. However, this analysis formally retrieves insights using data available for a very large number of dams. This type of analysis cannot pinpoint the real state of an individual dam, but can be very useful to prioritise attention on critical structures based on their characteristics.

Using a classification technique, this study identifies common characteristics of high-risk dams, which majorly comprehend dams built in the beginning of the 20th century or newly built (<10 years) embankment dams in low-GDP countries.

Looking at the future

This analysis identified that the current average failure probability remains well below the strictest accepted failure probability of 1 in 10,000 annually, with 85% of dams being at least twice as safe. However, with a global portfolio of 62,000 large dams in 2024, failures are inevitable. This research es-

timates 23 failures of large dams between 2023 and 2035. Yet these projections do not account for the construction of new dams, the consequences of climate change, or human conflicts, which could influence failure rates and lead to higher numbers.

Identifying inherent risks—through a combination of failure probability assessment and impact evaluation on downstream populations and infrastructure—is essential for guiding risk-informed decision-making. A proactive approach that integrates monitoring, maintenance, and policy interventions will be crucial to ensuring that dam safety keeps pace with changing environmental and socio-economic conditions.

Our future predictions align with 120 years of observed trends, yet it remains key to monitor evolving risk factors.

Antonio Moreno-Rodenas (Lead author and hydraulic engineer at Deltares)

Dam safety expert at Deltares and lead author, Antonio Moreno-Rodenas, emphasises the study's significance: "Dam safety is a complex issue that depends on detailed knowledge of each structure's condition, design, and operational environment. Our future predictions align with 120 years of observed trends, yet it remains key to monitor evolving risk factors—such as deglaciating basins, increasing extreme events, and geopolitical conflicts. Ensuring we accurately quantify these risks is crucial to supporting effective policies for dam safety."

Flood-resilient communities

The research team is now expanding their work to improve the understanding of risks and benefits around dams. Daniel Valero (Imperial College) highlights that "keeping reservoirs safe is critical to meet water, food and energy challenges that many countries are already intensely experiencing".

The collaboration between Imperial College London and Deltares also works towards accelerating current dam safety profiling, through the use of artificial-intelligence and remote sensing to map infrastructure, and the rapid evaluation of vulnerability and population at risk. These efforts aim toward enhancing dam safety and ensuring flood-resilient communities worldwide.

(Deltares, 7 March 2025, https://www.deltares.nl/en/news/a-century-of-dam-safety)

Age, climate and economic disparities drive the current state of global dam safety

Antonio Moreno-Rodenas, Juan Diego Mantilla-Jones & Daniel Valero

Abstract

Dams are essential for flood protection, water resources management, energy generation and storage and food production. However, the consequences of their failure can be catastrophic, as demonstrated by recent examples. Here this study revisits dam failures worldwide since 1900, analysing key factors driving the failure risk, profiling current dam safety and providing an outlook to the near future. Similar to previous analyses (1970s to 2010s), we observe a strong infant mortality, which remains especially important for the development of new embankment dams, while recent concrete dams have become more resilient. In contrast, hazard signals related to ageing remain yet less apparent, contrary to common belief. Nevertheless, given their abundance, we expect decades-old dams to be prevalent in future failure statistics—especially for embankment dams of height between 15 and 70 m built in the second half of the last century. This highlights the relevance of investments in monitoring, maintenance and uprating, which, if ignored, could become a substantial liability and a major vulnerability, especially in the context of increased flooding frequency. We uncover a trend of increased failure rates of newly constructed dams in low-income regions, which coincides with areas where a substantial hydropower potential remains untapped. This is especially intensified in monsoon-dominated climates, whereas the pattern of construction and failures is more homogeneous across other major climatic regions. Our statistical analysis suggests that 23 (95% confidence interval 14–33) large dam failures are to be expected worldwide in the near future (2023–2035), with currently ~4.4% of large dams having a probability of failure larger than 1/10,000. Contrarily, 85% of large dams are at least twice as safe as this threshold, commonly embraced in policy. These findings can support the targeted allocation of limited resources for the future-proofing of infrastructure, thereby contributing to water, food and energy security.

Nature Water **volume 3**, pages 284–295 (2025), 07.March 2025, https://www.nature.com/articles/s44221-025-00402-1)

Sea level rise after the last ice age: more knowledge

Marc Hijma

Thanks to new geological data, we now know more about how fast and how much the global sea level rose after the last ice age, some 11,700 years ago. This information is of great importance for our current understanding of the impact of global warming on ice caps and thus on sea level rise. Researchers from Deltares, Utrecht University, TNO Netherlands Geological Service, Delft University of Technology, the Netherlands Institute for Sea Research (NIOZ), University of Leeds, University of Sheffield, University of Amsterdam, LIAG and BGR published their findings in the journal *Nature*.

Better understanding of sea level rise

The new knowledge into the rate of sea level rise during the early Holocene offers an important point of reference for scientists and policymakers, especially as we are now faced with a similar situation with rapidly melting ice sheets due to global warming. The research provides valuable new insights for the future.

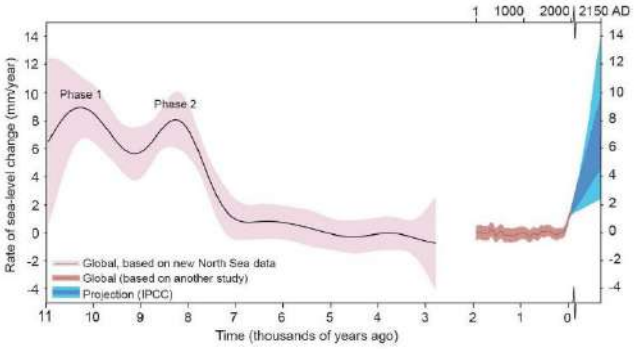
As a result of the current rise in greenhouse gas concentrations, climate models by the Intergovernmental Panel on Climate Change (IPCC) expect sea levels to rise by several metres by 2300. Some scenarios indicate a rise of more than one metre per century. An important difference with the early Holocene is that the consequences of sea level rise are far greater today and in the future. This is due to a growth in population and the current presence of infrastructure, cities and economic activity.

With this groundbreaking research, we have taken an important step towards a better understanding of sea level rise after the last ice age.

Marc Hijma, geologist at Deltares and the lead author of the study

Unique dataset in the North Sea region

Global sea level rose quickly following the last ice age. This was as a result of global warming and the melting of enormous ice caps that covered North America and Europe. Until now, the rate and extent of sea level rise during the early Holocene were not known due to a lack of sound geological data from this period. Using a unique dataset for the North Sea region, the researchers have now been able to make highly accurate calculations for the first time. They analysed a range of boreholes from the area in the North Sea that was once Doggerland, a land bridge between Great Britain and mainland Europe. This area flooded as sea level rose.



Global sea level will rise rapidly in the coming century; perhaps by more than 1 metre. This is primarily caused by increasing concentrations of greenhouse gases (source: IPCC). Submerged peat layers from the North Sea show that these rates were seen in two earlier phases: 10,300 and 8,300 years ago. Ice sheets melted then due to rapid warming after the last ice age. Source: Deltares (main author), TNO-Geological Survey of the Netherlands, NIOZ, Utrecht University, Delft University of Technology, University of Amsterdam, University of Leeds, University of Sheffield, LIAG, BGR.

By analysing the submerged peat layers from this area, dating them and applying modelling techniques, researchers showed that, during two phases in the early Holocene, rates of global sea level rise briefly peaked at more than a metre per century. By comparison, the current rate of sea level rise in the Netherlands is about 3 mm annually, the equivalent of 30 centimetres per century, and is expected to increase.

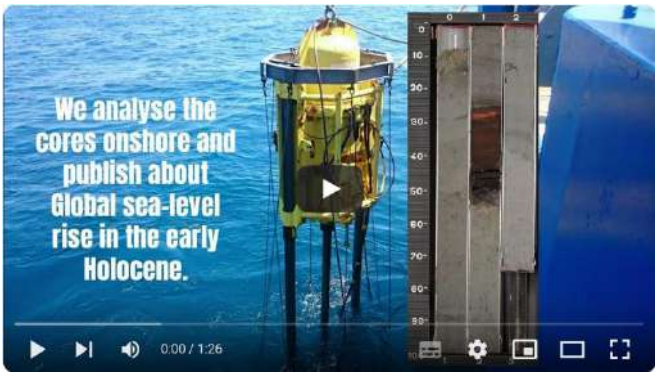
Furthermore, until now there has been considerable uncertainty about the total rise between 11,000 and 3,000 years ago. Estimates varied between 32 and 55 metres. The new study has eliminated that uncertainty and it shows that the total rise was around 38 metres.

Groundbreaking research

Marc Hijma, a geologist at Deltares and the lead author of the study: "With this groundbreaking research, we have taken an important step towards a better understanding of

sea level rise after the last ice age. By drawing on detailed data for the North Sea region, we can now better unravel the complex interaction between ice sheets, climate, and sea level. This provides insights for both scientists and policy-makers, so that we can better prepare for the impacts of current climate change, for example by focusing on climate adaptation."

The paper, 'Global sea-level rise in the early Holocene revealed from North Sea peats', was published in leading scientific journal Nature today. Download the findings in Nature



https://www.youtube.com/watch?v=nqdL4WOY6U0

(Deltares, 19 March 2025, https://www.deltares.nl/en/news/sea-level-rise-after-the-last-ice-age-more-knowledge)

Global sea-level rise in the early Holocene revealed from North Sea peats

Marc P. Hijma, Sarah L. Bradley, Kim M. Cohen, Wouter van der Wal, Natasha L. M. Barlow, Bas Blank, Manfred Frechen, Rick Hennekam, Sytze van Heteren, Patrick Kiden, Antonis Mavritsakis, Bart M. L. Meijninger, Gert-Jan Reichart, Lutz Reinhardt, Kenneth F. Rijsdijk, Annemiek Vink & Freek S. Busschers

Abstract

Rates of relative sea-level rise during the final stage of the last deglaciation, the early Holocene, are key to understanding future ice melt and sea-level change under a warming climate[1]. Data about these rates are scarce[2], and this limits insight into the relative contributions of the North American and Antarctic ice sheets to global sea-level rise during the early Holocene. Here we present an early Holocene sea-level curve based on 88 sea-level data points (13.7–6.2 thousand years ago (ka)) from the North Sea (Doggerland[3,4]). After removing the pattern of regional glacial isostatic adjustment caused by the melting of the Eurasian Ice Sheet, the residual sea-level signal highlights two phases of accelerated sea-level rise. Meltwater sourced from the North American and Antarctic ice sheets drove these two phases, peaking around 10.3 ka and 8.3 ka with rates between 8 mm yr^{-1} and 9 mm yr^{-1}. Our results also show that global mean sea-level rise between 11 ka and 3 ka amounted to 37.7 m (2σ range, 29.3–42.2 m), reconciling the mismatch that existed between estimates of global mean sea-level rise based on ice-sheet reconstructions and previously limited early Holocene sea-level data. With its broad spatiotemporal coverage, the North Sea dataset provides critical constraints on the patterns and rates of the late-stage deglaciation of the North American and Antarctic ice sheets, improving our understanding of the Earth-system response to climate change.

Nature **volume 639**, pages 652–657 (2025), https://www.nature.com/articles/s41586-025-08769-7

Seismologists analyze Myanmar's devastating M7.7 earthquake

Reet Kaur

An M7.7 earthquake struck near Mandalay, Myanmar, on March 28, 2025, killing more than 5 000 people and injuring at least 11 400. The shallow, high-magnitude event ruptured a long section of the Sagaing Fault, prompting seismologists to investigate its complex rupture dynamics and evidence of supershear propagation.

Collapse of New Headquarters of the State Audit Office (Thailand) after the 2025 Myanmar earthquake, pictured from JJ Mall, Bangkok. Image credit: Supanut Arunoprayote

A powerful M7.7 earthquake struck 16 km (10 miles) northwest of Sagaing, near Mandalay, Myanmar, on March 28, 2025, at 12:50 local time (06:20 UTC). The shallow strike-slip event occurred at a depth of approximately 10 km (6 miles) along the Sagaing Fault and was the strongest instrumentally recorded earthquake in Myanmar since 1912. It caused widespread damage across central Myanmar, northern Thailand, southern China, and parts of Vietnam.

The earthquake caused more than 5 000 fatalities in Myanmar, 51 in Thailand, and one in Vietnam, reportedly due to cardiac shock

At least 11 400 people were injured, and hundreds remain missing, including workers trapped at a construction site that collapsed in Bangkok. Extensive infrastructure damage was reported, particularly in Mandalay and Sagaing, where buildings, bridges, and dams sustained severe structural impacts.

Seismologists reported that the Sagaing fault, a major tectonic boundary, ruptured over 400 km (250 miles). This rupture, among the largest globally, exhibited a "supershear" speed, traveling faster than the speed of sound following an initial slow phase. Ground shaking extended over 100 km (62 miles), with Modified Mercalli Intensity levels exceeding VIII in multiple regions.

According to the U.S. Geological Survey (USGS), the earthquake's shallow depth amplified ground shaking across the region, contributing to widespread structural damage. Liquefaction—where saturated soil temporarily loses strength and behaves like a liquid—was observed in multiple locations, further intensifying damage. An M6.4 aftershock struck 12 minutes later, and continued seismic activity in the following days has sustained concerns about regional stability and secondary hazards.

Researchers from Johns Hopkins University and the USGS used satellite imagery to map the surface rupture and assess structural damage in Mandalay. This rapid geospatial analysis supported emergency response teams by identifying the most severely affected areas and demonstrated the increasing role of satellite data in real-time assessment of earthquake damage.

For the first time during a large-magnitude earthquake, a submarine telecommunication cable network equipped with more than 100 seismic sensors detected ground motion in real time. According to Mikael Mazur of Nokia Bell Labs, the system provided continuous seismic data during the event, offering valuable insights into offshore ground motion.

This integration of seismic sensing into undersea infrastructure represents a step forward in expanding global earthquake monitoring capabilities, particularly in regions with limited land-based instrumentation.

X ← Post

Chindwin News Agency
@TheChindwin

A team of surveyors in Myanmar has completed their evaluations, confirming that the fissures resulting from the 7.7 magnitude earthquake on March 28 have extended over a remarkable distance of 500 kilometers, which equates to more than 342 miles. The earthquake was centered in Sagaing and its effects reached into the northern Bago region, as well as parts of Shan State. This assessment highlights the extensive impact of this seismic event on the affected areas.

Photo/Nyo Min

5:06 PM · Apr 18, 2025 · 6,673 Views

At the Seismological Society of America's Annual Meeting on April 15 in Baltimore, researchers presented preliminary analyses of the rupture. The earthquake occurred within a seismic gap that had remained inactive since 1839, located between the rupture zones of the 1929 Naypyidaw and 1956 southern Sagaing earthquakes. The spatial overlap with previous events highlights the structural complexity of the Sagaing Fault system.

Ground motion studies led by Hiroshi Kawase and colleagues since 2014 have provided detailed data on local site conditions in cities such as Sagaing and Yangon. Their findings help explain the amplified shaking observed in distant regions like Bangkok, where shallow sedimentary layers contributed to increased ground motion. This research supports more accurate seismic hazard assessments in urban areas across Southeast Asia.

In Thailand, the earthquake caused severe ground shaking, leading to substantial damage and casualties. A 33-story building under construction in Bangkok's Chatuchak district collapsed, resulting in at least 47 fatalities and 53 individuals reported missing. The disaster prompted Thai authorities to declare a state of emergency in Bangkok and other affected regions.

In China's Yunnan Province, the earthquake resulted in the damage of approximately 847 homes, affecting around 2,840 individuals. Two people sustained injuries in the border city of Ruili. Chinese authorities have deployed rescue teams and are providing assistance to those impacted by the disaster.

A dashcam still of an under construction government office skyscraper in Bangkok collapsing due to the 2025 Myanmar earthquake. Image credit: Jack Brown

In Vietnam, the earthquake's tremors were felt in Ho Chi Minh City, causing damage to over 400 apartments. One person died from shock during evacuation efforts.

Myanmar's ongoing humanitarian crisis—affecting more than 20 million people and displacing 3.5 million—is complicating emergency response operations. Following the earthquake, the military government declared central Myanmar a disaster zone and formally requested international assistance.

References:

[1] Seismologists Share Early Analyses of Myanmar Earthquake – Seismological Society of America – April 15, 2025

[2] Over 4 400 dead after deadliest earthquake in 95 years strikes Myanmar – The Watchers – March 29, 2025

[3] Violent M7.7 earthquake hits Sagaing, Myanmar, leaving over 4 400 fatalities, 5 400 injured and many missing – The Watchers – March 28, 2025

(Reet Kaur / THE WATCHERS, Sunday, April 20, 2025, https://watchers.news/2025/04/20/seismologists-analyze-myanmars-devastating-m7-7-earthquake/)

Everything Flows: Refining the Laws of Friction in Caltech's "Seismological Wind Tunnel"

Imagine a heavy book resting on a table. If you try to gently push the book across the table with the tip of your finger, it may first appear to remain motionless—it needs a lot more force to start sliding visibly. Similarly, if you slowly start tilting the table upward, the book still appears to remain motionless, sticking to the table through friction until the table's tilt reaches some critical angle and the book suddenly slides down. This transition from apparent stillness to sudden movement under large forces is seen in earthquakes and landslides.

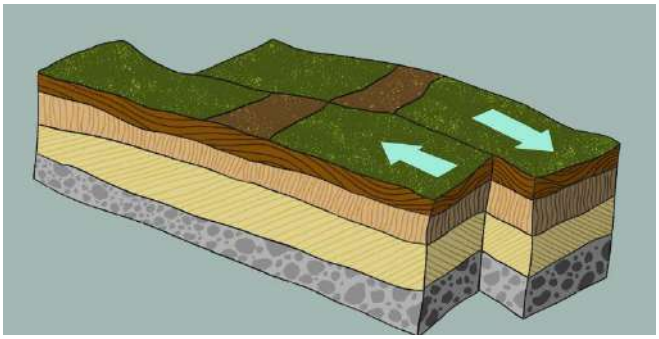


Illustration of two crustal plates interfacing along a fault. The plates slowly slide opposite to each other with shear motion. When the fault suddenly slips dramatically, an earthquake occurs.

Friction between two sliding interfaces historically has been modeled with a simple expression called Coulomb's law. Now, Caltech researchers have demonstrated that Coulomb's law is insufficient for describing reality, and that interfaces subjected to shear and pressure, though they may appear motionless, are, in fact, always sliding at rates imperceptible to the human eye.

These new observations, reported in a paper appearing online on March 12 in the journal *Nature*, provide a more precise understanding of the mechanics of earthquakes and landslides, and have major implications for the engineering of materials interfaces.

The work is a collaboration between the research teams of Ares Rosakis, the Theodore von Kármán Professor of Aeronautics and Mechanical Engineering, and Nadia Lapusta, the Lawrence A. Hanson, Jr., Professor of Mechanical Engineering and Geophysics.

When two surfaces are in contact, whether they are a book and a table or two plates of the Earth's crust pressed and sheared along a fault, Coulomb's law indicates that there is a certain quantity, called the "coefficient of static friction," that must be overcome before the interfacing surfaces start sliding. In other words, Coulomb's law states that the two compressed interfaces are completely motionless unless enough shear force—a force parallel to the direction of the interface—is applied.

Coulomb's model may seem intuitive, but, for decades, researchers who study rock mechanics and faults have known that it may not be the full story. These scientists have introduced more detailed equations, called rate-and-state laws, in which friction depends on the sliding rate and the evolving states of the sliding interfaces. Rate-and-state laws predict that there is no static friction coefficient and that shear movement occurs under all shear forces—so, for ex-ample, even the slightest pushing of a heavy book with the tip of your finger will cause the book to slide some tiny, imperceptible amount.

In the new paper, the team presents the first direct proof that motion is happening even at shear forces lower than those implied by the apparent static friction coefficient, validating the rate-and-state laws. In laboratory studies, the team used an optical method called digital image correlation (DIC) and a camera trained on two surfaces in contact. They determined that, under shear, the surfaces slid over each other at a rate as small as 10-12 meters per second, or 0.000000000001 meters per second. At this rate, a fraction of a millimeter of slip would accumulate in one year.

The contacting surfaces were made of a kind of plastic that emulates the sliding rock interfaces responding to shear forces in analogous ways. This study extends Caltech's practice of re-creating and studying surrogate earthquake processes in the laboratory, research enabled by the 30-year-old Caltech "seismological wind tunnel," a facility at the Graduate Aerospace Laboratories (GALCIT) created by Rosakis (a former GALCIT director) and seismologist Hiroo Kanamori, the John E. and Hazel S. Smits Professor of Geophysics, Emeritus, and former director of Caltech's Seismological Laboratory. The facility is devoted to the creation of experimental analogues of the physical processes involved in earthquake rupture.

Everything flows: even though objects may appear motionless under force, new formulations for the laws of friction indicate that they actually slip tiny, near-imperceptible amounts.

"In the words of ancient Greek natural philosopher Heraclitus, everything flows; everything moves, nothing is ever stationary," Rosakis says. "Specialists have suspected that there is no static friction coefficient, but now we have conclusively proven this by using optical micro-measurements of unprecedented accuracy directly at the interface to validate the advanced friction laws and to promote their use in other fields."

Additionally, the researchers found that when two objects have been held in contact for an extended period of time, called "hold time," they tend to "stick" together more so than if they had just come into contact. This evolving adhesion is a phenomenon called "healing," in which microscopic contact areas locally strengthen and increase over time, making the interface more resistant to sliding. In the paper, the team also quantified healing by measuring how it slows down the microscopic sliding that occurs under small forces.

"One may wonder why measuring such minute sliding rates are important; after all, they are close to zero as the concept of the static friction coefficient would predict," Lapusta says. "The importance is not just in validating rate-and-state friction but also in quantifying the interface healing. Rate-and-state friction laws predict that the healing should manifest itself in the decrease of sliding rates, which is exactly what

we measure, enabling us to quantify healing. This, in turn, allows us to predict how the interface would resist a sliding event, such as an earthquake rupture propagating along a fault."

Indeed, the team found that the friction between the interfaces during rapid sliding would be significantly larger—around 20 percent larger—for interfaces that had been in contact for a year versus five minutes, for example.

"Many modelers of earthquakes and landslides still use a simpler friction law, which does not incorporate the effects of healing," says study first author Krittanon (Pond) Sirorattanakul (PhD '24), now a researcher at Chevron. "We hope that our work will encourage the community to recognize the importance of healing in these studies."

In addition to enabling better modeling of earthquakes and faults, the findings have major implications for the design and control of frictional experiments. "Our team has had occasional problems with reproducibility of earthquake ruptures in the lab," Rosakis explains. "Now we know that if you set up your experiment, then take a lunch break, those surfaces are healing during that time, and your earthquake rupture results will be significantly different!"

The paper is titled "Sliding and healing of frictional interfaces that appear stationary." In addition to Sirorattanakul, Lapusta, and Rosakis, co-authors also include former graduate student Stacy Larochelle (PhD '22), now a postdoctoral research scientist at Columbia University's Lamont-Doherty Earth Observatory; and Vito Rubino, a former research scientist in aerospace at Caltech, now an associate professor at École Centrale Nantes, France, who is a longtime collaborator of Rosakis and Lapusta. Funding was provided by the National Science Foundation (NSF)-IUCRC Center for Geomechanics and Mitigation of Geohazards (GMG) at Caltech, the NSF, and the US Geological Survey.

(Caltech News, March 13, 2025, https://www.caltech.edu/about/news/everything-flows-refining-the-laws-of-friction-in-caltechs-seismological-wind-tunnel)

Dear Colleagues,

This recent "*Nature*" paper and *Caltech* press release may be of interest:

Caltech Press release entitled ***"Everything Flows: Refining the Laws of friction in Caltech's seismological wind tunnel"***. Link : Caltech News

Nature paper link: https://www.nature.com/articles/s41586-025-08673-0

Sliding and healing of frictional interfaces that appear stationary

K. Sirorattanakul, S. Larochelle, V. Rubino N. Lapusta, A. J. Rosakis

Abstract

Frictional interfaces are found in systems ranging from biological joints to earthquake faults. When and how these interfaces slide is a fundamental problem in geosciences and engineering. It is believed that there exists a threshold shear force, called static friction, below which the interface is stationary, despite many studies suggesting that this concept is outdated. By contrast, rate-and-state friction formulations predict that interfaces are always sliding, but this feature is often considered an artefact that calls for modifications. Here we show that nominally stationary interfaces subjected to constant shear and normal loads, with a driving force that is notably below the classically defined static friction for which creep is known to occur, are sliding, but with diminishingly small rates down to 10^{-12} m/s. Our precise measurements directly at the interface are enabled by digital image correlation. This behavior contradicts classical models of friction but confirms the prediction of rate-and-state friction. The diminishing slip rates of nominally stationary interfaces reflect interface healing, which would manifest itself in higher peak friction in subsequent slip events such as earthquakes and landslides, substantially modifying their nucleation and propagation and hence their hazard.

Cheers,

Ares

Ares J. Rosakis, NAS, NAE, Amer. Acad. of Arts @Sci, ForMemRS.

Theodore von Kármán Professor of Aeronautics and Professor of Mechanical Engineering
Graduate Aerospace Laboratories (GALCIT)
CALIFORNIA INSTITUTE OF TECHNOLOGY
1200 E California Blvd | MC 105-50 | Pasadena CA 91125
295 Firestone | (626) 395-4523
http://www.rosakis.caltech.edu | caltech.edu |
https://eas.caltech.edu/|galcit.caltech.edu

Tunnel for foot passengers in Stockholm

IN THE ENGINEER of December 4th we drew attention to the recent employment of a cold air machine for freezing wet gravel in the construction of a tunnel at Stockholm. Through the courtesy of the contractor, Captnin Lindmark, of the Swedish Royal Engineers, we are now in a position to place before our readers further particulars of this interesting and novel work.

The most populous part of the Swedish capital is situated on the north shore of the lake l\Ialaren, and is divided into two districts, of about equal extent, by an elevated ridge of stones and gravel, the ridge, which runs in a northerly direction from the lake, and which in some places attains a height of 70ft., constituting a great impediment to traffic.

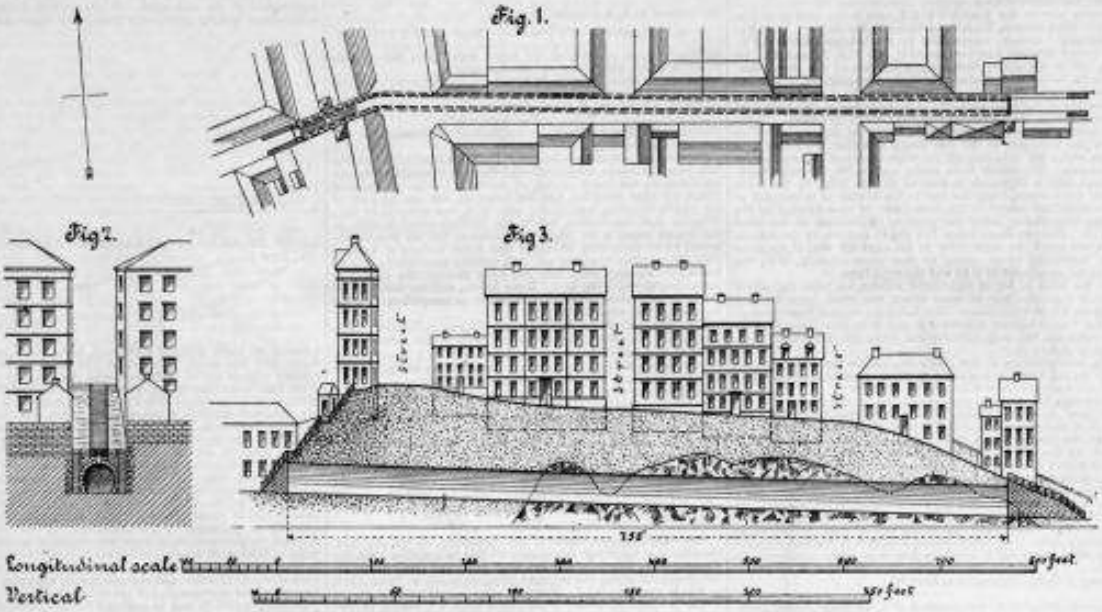
In order to afford an imp·oved communication between the two districts, Captain Lindmark applied to the municipality of Stockholm for powers to construct, on his own account, a tunnel for foot passengers through the hill, and to levy a toll of 2 öre, or 27 of a penny, on each person passing through, for a period of fifty years, the tunnel afterward to become the property of the town with out any indemnity whatever. This application was strongly opposed, not only by the owners of adjacent houses, but by engmeera, who stated that driving a tunnel through loose stones and gravel, as proposed, would necessarily cause great subsidences in the ground, and consequent damage to the buildings above. The municipality, however, considering the great benefit that would result from the realisation of the project, granted the concession, and in the summer of 1884 the works commenced

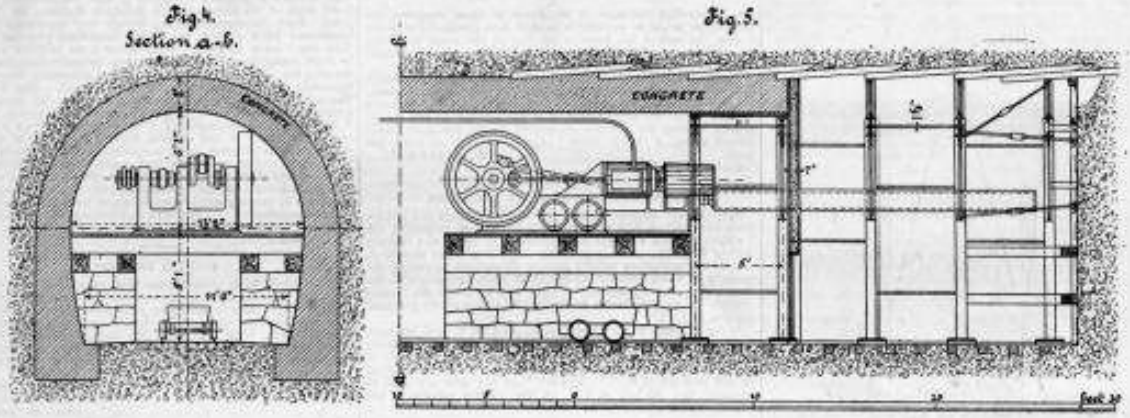
https://www.theengineer.co.uk/content/archive/april-1886-the-brunkebergs-tunnel

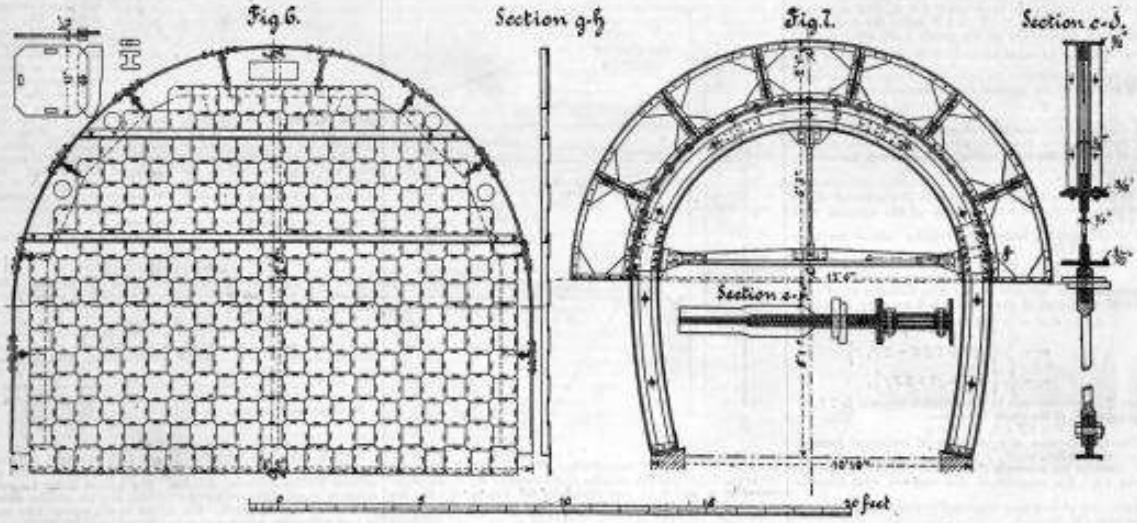
TUNNEL FOR FOOT PASSENGERS, STOCKHOLM.

CAPTAIN LINDMARK, ENGINEER.

(For description see page 282.)







BUENOS AYRES SEWAGE PUMPING ENGINES.

The pumping engines illustrated by the engravings on pages 281 and 284 have been made to the designs of Messrs. Browne and Boby, of 11, Queen Victoria-street, London, for pumping sewage in two of the outlying districts of Buenos Ayres, and form a portion of the improvements in that city which are being carried out by Mr. J. F. La Trobe Bateman, M.I.C.E., for the Argentine Government. The constructors are Messrs. Thomewill and Warham, of Burton-on-Trent.

The engines have to fulfil a number of requirements, which may be stated as follows:—(1) The sites at disposal for the engine-houses being exceedingly limited, it is necessary that the engines should occupy very little space. (2) Fuel being expensive, economical working is imperative, and under great differences of speed, as for several hours of the day the engines are required to do their full work, and for the remainder of the twenty-four hours only about one-fifth of that amount. (3) As the engine-houses are situated in populous suburbs, and in the close vicinity of dwelling-houses, condensing engines are desirable for quietness of working, but no water is available for the purpose of condensation. Messrs. Browne and Boby's designs were selected by Mr. Bateman as meeting all these requirements.

The engines contain several novel and very ingenious and noteworthy details. They are compound condensing, constructed on Messrs. Browne and Boby's patented system, and have hand variable expansion valves on the high-pressure cylinders. The action of the steam-moved slide-valves is of a positive character, so that the engines can be worked, when necessary, at as slow a speed as may be desirable. For economy of space, the high-pressure cylinder is superimposed on the low-pressure cylinder, the pistons of both being connected by their piston and connecting rods to one end of a bell crank, the other end of which actuates the pump. The pumps are placed down the well, close to the sewage level; and the delivery pipes, just above the

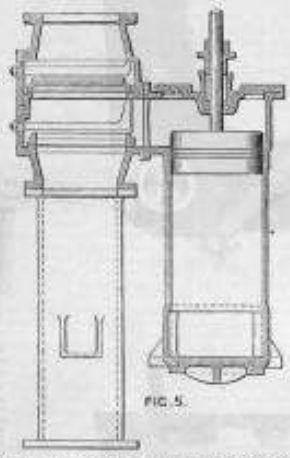


FIG. 5.

pumps, have surface condensers formed in them, the sewage forming the cooling fluid, and passing through four tubes whose united sectional areas are slightly in excess of the area of the main delivery pipe. Curved deflectors are attached inside the end covers of the condensers, to prevent undue friction in the flow at these angles. The air-pumps are worked from levers keyed to the shafts of the bell cranks. They stand at a lower level than the condensers, so that a good fall is obtained for the condensed water to their suction valves. The whole of the condensers, air-pumps, and delivery connections to main are placed below the floors of the houses for economy of space. Four sets of engines, boilers, and pumps have been constructed, two to each of the two houses; and in each case one set of engines, boilers, and pumps is to work continuously, the other set being provided as a stand-by. The maximum work to be performed is in one case the raising of 1429 gallons per minute, against a total head of 26ft.; in the other case, 638 gallons per minute, against a head of 25ft.

The details of the engines are arranged with a view to securing uniformity of length of stroke under varying loads, and also very small clearance between the pistons at the ends of their strokes and the cylinder covers. The pistons are also caused to rest momentarily at the ends of their strokes, so as to allow the

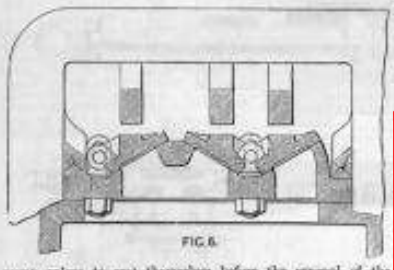


FIG. 6.

pump valves to seat themselves before the reversal of the current. In raising the minimum quantity the vacuum will perform the greater part of the work. Under these conditions, the exhaust side of the low-pressure piston being entirely free from steam, it becomes necessary to cushion it by means of steam introduced direct to the low-pressure cylinder at about the end of the stroke, and to ensure uniformity of length of stroke this cushion must be independent of the reversal of the main slide, and consequently the steam must proceed from a source other than the high-pressure cylinder. The steam from the boiler enters the expansion valve chest, as shown on the side elevation of the engine at Fig. 1. This valve chest is shown in detail at Fig. 3. It consists of a cylinder with two piston valves cutting off by their inner edges, the steam being admitted at the centre of the chest. The outer valve is forged in one piece with its rod, upon which is attached a hand wheel, and by turning this wheel both valves are revolved and the cut-off adjusted by means of the right and left-hand threads, as shown. The valves take their motion direct from a lever on the rocker shaft, seen in Fig. 1. The chest is constructed with a liner at each end, by means of which a very narrow annular port is formed all round its bore, giving a sharp cut-off, and maintaining the balance of pressure round the valves. The expansion valve chest is attached to the inner ends of the two main slide chests of the high-pressure cylinder, the steam passing into these latter through passages leading from the annular ports. The main steam ports in both high-pressure and low-pressure cylinders enter at a short distance from the cylinder ends, so that the pistons cover them before their strokes are completed. A small amount of the exhausting steam is thus imprisoned in the ends of the high-pressure cylinder, and to some extent forms a cushion, which, however, would not be sufficient to be depended upon with so short a cushion space. To form the necessary amount of cushion the device shown on the section of the high-pressure cylinder, Fig. 5, is adopted as follows:—A passage is drilled from the pressure side of the piston, leading out to the centre of its periphery, and a corresponding passage is drilled leading from the bore of the cylinder to its end. At the time that passage in the piston corresponds with this port, steam is admitted from the driving to the exhaust side of the piston, and as the stroke is continued the passages are shut off and the steam confined and compressed, forming an absolute cushion; the main steam port is covered by the piston at the moment that the two passages commence to open into each other. A small port from the main slide face is provided, which, upon the reversal of the main slide, is opened, and steam is admitted through it to start the piston slowly on its return stroke. A small valve is provided in the cushioning passage to prevent steam passing through to the exhaust side as the openings of the ports repass each other.

The cushioning of the low-pressure piston is accomplished by admitting exhaust steam from the small supplementary cylinder which actuates the main slides; this supplementary cylinder is shown in detail at Fig. 4, and it will be seen that it has a slide valve with two exhaust cavities, and working on a face in which are two exhaust ports, which are connected respectively to the ends of the low-pressure cylinder. The small slide is actuated by a rocking lever taking its motion from a pin on the bell crank, and which comes in contact with adjustable stops, as shown, upon the spindle of the double-ported slide. The stops are set so that when the pistons are just covering the main ports the small slide commences to release the steam in one end of the supplementary cylinder, and consequently its admission to the end of the low-pressure cylinder. The low-pressure cylinder is provided with small restarting ports uncovered by its main slide as is the high-pressure cylinder. From the above description it will be seen that the cushioning in both cylinders is quite independent of the reversal of the main slide valves, also that the steam used in cushioning and in driving the piston of the supplementary cylinder does not in any way detract from the economy of working, as it is afterwards utilised in the main cylinders. It is evident that the engines cannot commence to cushion till the main ports are closed, so that only a very slight variation in the length of stroke can occur under any circumstances. The principal dimensions of the engines are as follows:—High-pressure cylinder, 7½in. diameter; low-pressure cylinder, 13in. diameter; stroke, 30in. Diameter of pumps in one house, 15in.; diameter of pumps in other house, 14in.; the stroke being 24in., as in the engines. The low-pressure cylinders are steam jacketted. The engines when tested under steam in this country were necessarily run light, and the indicator diagrams given on page 284 illustrate the action of the engines under these circumstances.

In diagram No. 1, page 284, it will be seen that a considerable amount of vacuum existed in the high-pressure cylinder—a condition very unfavourable for cushioning, and which could not occur if any load were on the engines; but even under these circumstances a good cushion is formed in the low-pressure cylinder. Diagram No. 2, taken with the exhaust passing to the atmosphere, shows the sharpness of the cut-off by the expansion valves. In this diagram it will be seen that but little cushioning takes place at the "crank end," the reason of which is that when moving in that direction—which in this case was at a slower speed than when the vacuum was in action—the pistons have to raise the unbalanced weight of the arm of the bell crank, &c. In actual work the engines will make their in-stroke more quickly than the out-stroke, which is, of course, not in any way detrimental to their efficiency, while the space which would be occupied by a balance weight is saved. The vacuum for purposes of trial was obtained with a temporary condenser. For convenience in starting, a connection is arranged from the centre of the expansion valve chest to the steam inlet of low-pressure cylinder, so that high-pressure steam can be turned into it.

The pumps, of which a section is given in Fig. 5, are double-acting, and fitted with pistons having cast iron packing rings. A detail of the valves is shown at Fig. 6. These are of cast iron, of the hinged form, but free to lift as far at the hinged as at the free side. The seatings are wedged into the valve-boxes with wooden wedges. The foot valves are of similar construction. The boilers of the vertical type are fitted with Field tubes. Each boiler can be placed in communication with either engine, and the donkey pump on each boiler can be steamed from either, and also will feed into either, as may be desired.

TUNNEL FOR FOOT PASSENGERS IN STOCKHOLM.

In The Engineer of December 4th we drew attention to the recent employment of a cold air machine for freezing wet gravel in the construction of a tunnel at Stockholm. Through the courtesy of the contractor, Captain Lindmark, of the Swedish Royal Engineers, we are now in a position to place before our readers further particulars of this interesting and novel work.

The most populous part of the Swedish capital is situated on the north shore of the lake Malaren, and is divided into two districts, of about equal extent, by an elevated ridge of stones and gravel, the ridge, which runs in a northerly direction from the lake, and which in some places attains a height of 70ft., constituting a great impediment to traffic.

In order to afford an improved communication between the two districts, Captain Lindmark applied to the municipality of Stockholm for powers to construct, on his own account, a tunnel for foot passengers through the hill, and to levy a toll of 3 ore, or ·27 of a penny, on each person passing through, for a period of fifty years, the tunnel afterward to become the property of the town without any indemnity whatever. This application was strongly opposed, not only by the owners of adjacent houses, but by engineers, who stated that driving a tunnel through loose stones and gravel, as proposed, would necessarily cause great subsidences in the ground, and consequent damage to the buildings above. The municipality, however, considering the great benefit that would result from the realisation of the project, granted the concession, and in the summer of 1884 the works commenced.

As shown by the engravings, Figs. 1, 2, and 3, on page 281, the tunnel follows the direction of a narrow street, scarcely wider than the tunnel itself. This plan, though perhaps not the best for the safety of the houses during construction, being adopted in order to avoid appropriation of valuable property. The tunnel has a length of 758ft., a height of 12ft. 8in., and a width of 13ft. 2in. The works were commenced from the east end by driving a heading at the bottom level—a matter which offered no difficulty, as the heading passed entirely through granite which was blasted by dynamite. The enlargement of the heading, however, caused considerable trouble, because the crown of the tunnel in several instances passed into fine sand lying close to the rock. At such places explosives could not be used, and the rock had to be broken by means of wedges, which was a slow and expensive method. The driving of the tunnel from the west end introduced difficulties of a more serious nature, because the ground to be pierced consisted entirely of coarse gravel, intermixed with large stones and a small quantity of wet clay. Fifty feet from the mouth the tunnel passes between two valuable houses, five stories high, built on the slope of the ridge. The distance between these houses was so small that the side walls of the tunnel had to be constructed right under their foundations, which extended down to within 10ft. of the top of the arch. The foundations of the houses could not in this case have been brought down to the bottom of the tunnel by underpinning—partly on account of the great depth, but chiefly from the loose nature of the ground. The system invented by the Austrian engineer Rziha was from the beginning adopted as being the safest under such difficult conditions. Moreover, an iron wall of plates, 12in. square, as shown in Figs. 5, 6 and 7, was made to place against the face of the tunnel as the excavation advanced. Notwithstanding these precautions, the results were not satisfactory. It was found that the gravel, on account of the water and clay it contained, had no cohesion whatever, and would pass freely through even a very small opening. The consequence was that a subsidence took place in the ground above; and the excavations had not advanced more than 40ft. when the works had to be stopped, experience showing that if it was proceeded with the houses would in all probability come down.

Under these circumstances Captain Lindmark decided to freeze the earth before making the excavation by means of cold air, and for this purpose he procured from Messrs. Siebe, Gorman, and Co., London, one of Lightfoot's patent dry air refrigerators capable of delivering about 25,000 cubic feet of cold air per hour, which was erected in the tunnel as close as possible to the part to be operated on. The position and arrangement of the machine is shown in Figs. 4 and 5. The inner part of the tunnel was formed into a freezing chamber by means of a partition wall made of double planking filled in with charcoal.

In the middle of September last year the works were renewed. By running the refrigerator continuously for sixty hours the gravel inside the freezing chamber was frozen into a solid mass to a depth varying from 5ft. near the bottom of the tunnel to 1ft. near the top. At the crown no freezing took place, and though the temperature at the bottom was as low as 40 deg. below zero Fah., the thermometer would indicate 32 deg. above zero at the top, or 16ft. above the floor. This circumstance, however, did not occasion any inconvenience, but rather the reverse, as in any case it would have been necessary to support the roof with planking, which it would have been almost impossible to drive in if the gravel had been frozen. The work was now proceeded with as before, in sections of 5ft., the excavation commencing at the top, and the iron wall being built up from above downwards as fast as possible. But the great difference was that now the whole mass of gravel and stones was solid; indeed, for some 5ft. or 10ft. from the bottom the iron wall was dispensed with, the gravel forming such a hard and compact mass that it had to be cut away with special tools. After the first commencement it was sufficient to run the refrigerating machine on the average from ten to twelve hours every night, though after heavy rains, when much water percolated through the gravel, it had to work somewhat longer. The machine delivered the air at a temperature of 67 deg. below zero Fah., and worked admirably all the time without a single hitch or stoppage of any description. The temperature in the freezing chamber was generally from 6 deg. to 15 deg. below zero Fah., after ten or twelve hours' working, but it soon rose to freezing point when the workmen commenced their operations inside.

After two sections had been excavated the partition wall was removed forward, thus the contents of the freezing chamber varied from 3000 to 4000 cubic feet. The arching of the tunnel was completed as quickly as possible close up to the partition while the earth was still frozen. In this way a great deal of the planking could be removed, and the cavities filled up with masonry. In the top of the tunnel the planking could not be removed. The masonry is made up of concrete in the proportions of one of Portland cement to two and a half of sand and six of broken granite. By using concrete all the cavities were quickly and well filled, and subsidences avoided.

About 800ft. of the tunnel was driven by the aid of the Lightfoot refrigerator, with perfect success. In the residential house on the north neither subsidence nor cracks were perceptible two months after completion of the work at this point. In the house to the south the front has subsided about 1in., producing some small cracks in the walls. It is, however, to be observed that this house was not so well built as the other, subsidences having taken place in it long before the construction of the tunnel was commenced.

The daily progress while using the freezing method averaged 1ft. Since then the excavation has been carried out on much more favourable ground, consisting of pure sand, which possesses considerable cohesion, and can be safely cut away without being frozen. The daily progress now averages 2½ft.

In the middle of May it is expected that the tunnel will be completed and opened for public use. It will be lighted by means of Wenham's patent regenerative burners. The total cost of the undertaking, including all expenses, amounts to about £14,000, and to pay 10 per cent. on this sum, after clearing the working expenses it will require that 4400 persons should pass through every day.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Alfred Wood, fleet engineer, to the Northumberland; J. Stephens, staff engineer, to the Superb.

Leadbeater's Chair.—In our impression for June 12th, 1885, we described and illustrated Leadbeater's railway chair, in which a cast iron wedge and wrought iron key take the place of the ordinary wood key. A mile and a quarter of line on the Great Northern Railway has been laid within the last few weeks with this chair near Finsbury Park station, and about 500 yards near Holloway station.

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΑΤΡΩΝ
ΤΜΗΜΑ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

ΤΜΗΜΑ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

Επισκέψεις σε μεγάλα έργα υποδομής στην Δυτική Ελλάδα

Οι φοιτητές και φοιτήτριες του 4ου έτους του τμήματος Πολιτικών Μηχανικών του Πανεπιστημίου Πατρών των κατευθύνσεων εμβάθυνσης «Γεωτεχνική μηχανική- Έργα υποδομής» και «Υδραυλική Μηχανική – Τεχνολογία Περιβάλλοντος» και οι συνοδοί διδάσκοντες (Άγγελος Δημακόπουλος, Σταυρούλα Κοντοέ, Χριστόφορος Παππάς και Βασίλης Χριστόπουλος) επισκέφτηκαν στις 10-11 Απριλίου 2025 μεγάλα έργα υποδομής στη Δυτική Ελλάδα.

Το πρόγραμμα της πρώτης μέρας περιλάμβανε το υπό κατασκευή σύστημα αντλησιοταμίευσης στην περιοχή της Αμφιλοχίας. Οι φοιτητές μας παρακολούθησαν αρχικά την παρουσίαση των βασικών χαρακτηριστικών του έργου και στη συνέχεια ξεναγήθηκαν σε διαφορετικά σημεία ενδιαφέροντος: το φράγμα κυλινδρούμενου σκυροδέματος (RCC) του Αγ. Γεωργίου, το φρέαρ ανάπαλσης του φράγματος του Πύργου, σήραγγες προσαγωγής σε διάφορα στάδια κατασκευής, με προσωρινή υποστήριξη και εφαρμογή τελικής επένδυσης, καθώς και τα εκτεταμένα έργα οδοποιίας και ευστάθειας πρανών του εργοταξίου.




Το πρωί της δεύτερης μέρας ξεναγηθήκαμε στο φράγμα του Μετσοβίτικου στο μικρό Περιστέρι και στον υπό κατασκευή υπόγειο υδροηλεκτρικό σταθμό του. Το απογευματινό πρόγραμμα περιλάμβανε επίσκεψη σε έργα οδοποιίας, αντιστηρίξεις πρανών και κατασκευή οπλισμένου επιχώματος, στον αυτοκινητόδρομο Τέροβο – Καλέντζι. Το διήμερο πρόγραμμα ολοκληρώθηκε με επίσκεψη και γεύμα στο γεφύρι της Άρτας.


Ευχαριστούμε θερμά τις εταιρείες ΤΕΡΝΑ, ΤΕΡΝΑ ΕΝΕΡΓΕΙΑΚΗ, ΔΕΗ, ΑΚΤΩΡ και Εργοδυναμική Πατρών για τη φιλοξενία και τη ξενάγηση των φοιτητών μας στα υπό κατασκευή έργα τους.

Άγγελος Δημακόπουλος,
Σταυρούλα Κοντοέ,
Χριστόφορος Παππάς
Βασίλης Χριστόπουλος
Τμήμα Πολιτικών Μηχανικών Πανεπιστημίου Πατρών

SIMSG ISSMGE

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News

www.issmge.org/news

International Symposium on Land Reclamation, Ground Improvement and Coastal Protection (ISLGC-2025), 26-28 Nov 2025, Singapore

Siau Chen Chian / TC217 / 06-04-2025

The creation of new land through reclamation is common for urban expansion. Singapore has reclaimed land from the sea to expand its land area by about 25% over the past 60 years. Innovative use of reclaimed land as strategy for coastal protection against climate change induced sea levels rise has been proposed in the form of Long Island along east coast of Singapore. Ground improvement techniques are commonly used to treat the reclaimed land, to facilitate and accelerate the construction of structures for coastal protection and urban development.

The Geotechnical Society of Singapore (GeoSS) invites you to the International Symposium on Land Reclamation, Ground Improvement, and Coastal Protection (ISLGC), co-organized with ISSMGE Technical Committees TC217 and TC211, to be held on 26-28 November 2025. This symposium brings together renowned keynote and invited speakers to deliver state-of-the art lectures on the theme areas of the Symposium.

We invite researchers, engineers, contractors, developer and government agencies to submit abstracts showcasing research, innovations, and experiences in land reclamation, ground improvement, and coastal protection.

Supporting Organisations:
ISSMGE TC217 on Land Reclamation
ISSMGE TC211 on Ground Improvement
Centre for Soft Ground Engineering, National University of Singapore
Coastal Protection and Flood Resilience Institute Singapore, National University of Singapore
Centre for Urban Solutions, Nanyang Technological University, Singapore
Hong Kong Geotechnical Society (HKGES)
Chinese Taipei Geotechnical Society (CTGS)

CALL FOR NOMINATIONS FOR ISSMGE AWARDS AT 21 ICSMGE VIENNA 2026

ISSMGE IT Administrator / General / 07-04-2025

The ISSMGE offers awards to recognise those members who have made important contributions to our profession, society and the world.

The following awards are open for call for nominations in view of the attribution at the 21st International Conference on Soil Mechanics and Foundation Engineering 2026 (21 ICSMGE):

- ISSMGE Outstanding Technical Committee Award
- ISSMGE Outstanding Geotechnical Project Award
- ISSMGE Outstanding Innovator Award
- ISSMGE Outstanding Member Society Award
- ISSMGE Outstanding Paper Published in the International Journal of Geo-Engineering Case Histories Award
- ISSMGE Outstanding Public Relations Award
- ISSMGE Outstanding Young Geotechnical Engineer Award

Guidelines for the nomination of the various awards can be found by visiting the links above.

All nominations must be made through the local ISSMGE Member Society (except the Outstanding Paper Award and the Outstanding Technical Committee Award) and must reach the ISSMGE Secretariat by **30 September 2025** in time for the 21st International Conference on Soil Mechanics and Geotechnical Engineering (21 ICSMGE 2026) to be held in Vienna, Austria in 2026.

ISSMGE Interactive Technical Talk Episode 23: Earthquake Geotechnical Engineering and Associated Problems(TC203)

ISSMGE IT Administrator / TC203 / 16-04-2025

The twenty-third episode of International Interactive Technical Talk has just been launched and is supported by TC203. Sebastiano Foti, Thaleia Travasarou, Brendon Bradley and Francis Jenner Bernales are discussing with Marc Ballouz about "Earthquake Geotechnical Engineering and Associated Problems".

https://www.issmge.org/education/interactive-technical-talks

Future Focus - Africa & Europe Session, 2025: Call for Abstracts

ISSMGE IT Administrator / Time Capsule Project / 24-04-2025

Session Date: Wednesday 3 September 2025

Abstract Due Date: Wednesday 2 July 2025

Presentation Due Date: Wednesday 6 August 2025

Call for abstracts

A key element of the ISSMGE Heritage Time Capsule is the "Future Focus" phase. This phase is dedicated to reimagining the profession's roles by considering emerging challenges, societal expectations, technological developments, imagination, and philosophical approaches (https://htc.issmge.org/100-years-on).

We are hosting a webinar to encourage discussions among academics and practitioners in the geotechnical engineering field on future developments in Africa and Europe. Challenges of interest include aging infrastructure, sustainability and environmental concerns, research-practice gap, geohazards and need for resilience, geo education and professional development, global collaboration and knowledge sharing.

The webinar will be promoted to the global community of geotechnical engineering professionals in the 90 Member Societies of the ISSMGE, with an estimated membership of 40,000 members. Presentation proposals will be reviewed by a high-profile group of geotechnical engineers, under the chair of Dr Marc Ballouz, ISSMGE President.

We invite you to submit a title and 200-word abstract showing how the following could be used address the challenges highlighted earlier:

1. Human ingenuity
2. Emerging technologies (e.g., energy geotechnics, robotics, sensors etc.)
3. Artificial Intelligence

You are encouraged to experiment with modern tools (e.g., AI and LLM) but are requested to state clearly how these tools were used in generating content.

Abstracts must be accompanied by a brief write up of the applicant's background and career experience, no longer than 200 words. Further details will be required from those chosen to present on the webinar.

Invitations to present will be based on peer review of submitted abstracts and accompanying note on background and career experience.

Presentations

Participants need only prepare 10-minute presentations (i.e., no papers must be submitted). Presentations should consist of at least 2-slides, but no more than 5-slides. Presentation slides with a recorded voice-over must be submitted prior to the webinar for peer review.

Submissions

Responses are to be made using the following link: https://forms.gle/3yUfNarZ3c6dherH7

If you have any questions, please contact the HTC team at https://htc.issmge.org/contact

Call for Contributions: Advancing Numerical Methods in Geotechnical Engineering, Annual Prediction Event

Francesca Ceccato / TC103 / 29-04-2025

The **Numerical Methods and AI in Geotechnical Practice** subcommittee, under the **AGS Sydney Chapter**, is pleased to launch a new initiative: the **Annual Prediction Event**. This event is designed to foster innovation and practical application of numerical methods in geotechnical engineering through collaborative engagement.

To support this effort, we invite the **geotechnical engineering community worldwide** to contribute with **site investigations and monitoring data** to build a comprehensive database for the event.

International submissions are encouraged and highly welcomed.

Learn more and access the official call for contributions via the following links:

https://www.linkedin.com/feed/update/urn:li:activity:7322532597257904128

https://australiangeomechanics.org/2025/02/21/call-for-site-investigation-and-monitoring-data-contributions-for-ags-nsw-chapters-annual-prediction-event/

ISSMGE Europe

Dear Colleagues,

Following the warm response to our most recent ISSMGE Europe Newsletter, I would like to extend my sincere thanks for the engaging content many of you have shared. Your contributions continue to reflect the dynamism and depth of our regional community, and I am delighted by the interest it has generated across our member societies and internationally.

In parallel, I am pleased to note the successful **launch of the ISSMGE Europe website and LinkedIn channel**, which have begun to attract growing attention from our wider community. These platforms will serve as key spaces for updates, visibility, and engagement—and I encourage you to explore and follow them if you haven't already.

Also, if you haven't already done so, I kindly encourage you to **share the previous newsletter** with colleagues and national society members. Broadening its reach helps ensure that more voices are informed, inspired, and included in the ongoing dialogue.

As we begin preparing the next edition, we would be pleased to receive additional contributions, while we are always open to hearing about the activities within your societies and your upcoming events, I would like to incorporate new features such as:

- A **society spotlight** or leadership initiative,
- A particularly **notable project**, case study, or technical innovation,
- Or a **challenge**, trend, or study of relevance to our community.

We also plan to include an **editorial section**, which in this edition will reflect on how ISSMGE Europe can better support our national societies. As Vice President for Europe, one of my key priorities is to strengthen this support—practically and meaningfully. To that end, I would greatly appreciate your input:

What actions or initiatives could ISSMGE Europe take to serve your society more effectively?

If you have thoughts—particularly those that could be implemented in the near term—I would be grateful if you shared them. Selected insights may be highlighted in the editorial to initiate a broader conversation across our region.

If you would like to submit content, we kindly ask that it reach us by **23 May 2025** to allow time for review and integration.

Again, Thank you for your ongoing support and for sharing the important work and perspectives shaping geotechnical engineering across Europe.

Warm regards,
Lyesse Laloui
ISSMGE Vice President for Europe

SIMSG ISSMGE EUROPE

International Society for Rock Mechanics and Rock Engineering
ISRM

News

https://www.isrm.net

ISRM 2024 News Journal is now online 2025-04-04

The 2024 issue, volume 27, of the ISRM News Journal is now online on the ISRM website. Since 2012 the ISRM distributes the News Journal to all members in electronic version, and prints copies which are available at our sponsored symposia.

The News Journal includes news from the Society life, including board and regional reports, commission work, conference and symposia reports and papers from awarded members, among other content. Click here to read it directly on our website or to download it.

10th Latin American Rock Mechanics Symposium (LARMS 2026) - The Website has been launched 2025-04-16

The Brazilian Committee of Rock Mechanics, part of the Brazilian Association of Soil Mechanics and Geotechnical Engineering and the ISRM National Group, is honored to invite you to the 10th Latin American Rock Mechanics Symposium (LARMS 2026), which will take place from August 25 to 28, 2026, in Brasília, Brazil.

The theme of LARMS 2026 is: "Rock Mechanics for a Sustainable Future: Innovating in Mining, Energy, and Infrastructure."

The Website has been launched: https://larms2026.com/

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

News
https://about.ita-aites.org/ita-news/ita-news

Join the 11th webinar of WG23 focused on "Shaft Design and Construction for Transit Systems" 05 March 2025

ITACET Lunchtime Lecture Series #45 07 April 2025

Join the next LLS #45!

This instalment of the Lunchtime lecture series focused on **'Sustainable Tunnelling"** in collaboration with ITA Sustainability Committee.

This LLS#45 will run on April 8th at 13:00 CET time

The episode featured three lectures and finished with a Q&A with all speakers.

- Nikolai Bobylev - Planning for Sustainability
- Giuseppe Gaspari - Making Sustainability Design relevant in our projects
- Goetz Vollmann - Current approaches for the evaluation of sustainability of underground infrastructure

Registration: Lunchtime lecture series#45 | Itacet

Scooped by ITA-AITES #132, 17 April 2025

Rail or Road, India's longest tunnel of limitless possibilities

The huge new 24-mile tunnel China's about to build under world-famous river

Inside HS2: Meet London's miners working on the Northolt tunnels - UK

Monitoring Tunnel Constructions

Norway is building the world's longest and deepest subsea road beneath its fjords

Dubai tenders first two packages of £17bn sewerage tunnels project | United Arab Emirates

CPK awards Poland's largest single bore rail tunnel

Ontario launches tunnelling for final segment of Eglinton Crosstown | Canada

Nuclear power is in a hole. To get out, this start-up kept digging

From mining to metros: How ventilation technology is advancing South Africa's tunnels?

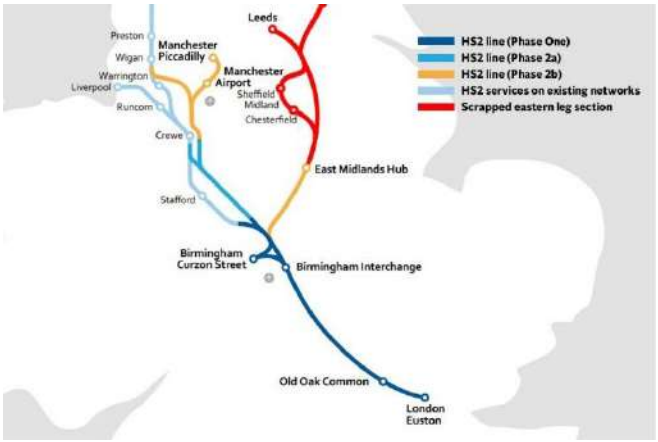
CERN completes feasibility study for 91km Future Circular Collider | Switzerland - France

Drone Tunnel Inspection System | Japan

BRITISH TUNNELLING SOCIETY
YOUNG MEMBERS

BTSYM April Webinar

Joint Webinar: BGA ECG - BTSYM - CFMS Jeunes - AFTES Jeunes
Tuesday, 8 April 2025, 12:00 - 13:00 (GMT+1)



Event Information:

UK Presentation: Design and Construction of Canterbury Vent Shaft - HS2

Canterbury Works Headhouse and ventilation shaft serves the Euston Tunnels for both ventilation and emergency access. This presentation focuses on the construction of the shaft and tunnels using underpinned segments, sprayed concrete lining, reinforced concrete collars and cast in-situ secondary lining. The presentation will be delivered by members of the construction and design team and will focus on the design and construction of the primary and secondary lining featuring geotechnical challenges, site setup, and innovation.

French Presentation: Swelling Soil Problematics in the Grand Paris Express Project

Grand Paris Express project aims at the development and extension of one existing metro line (Line 14) and the construction of four new metro lines (Line 15, 16, 17 and 18) around Paris and its suburban area. The project will achieve the construction of 200 km of new line and 60 new metro stations, mainly with tunnels and underground constructions. The project is leaded by the Société du Grand Paris, a public agency firstly created with the goal of leading this project. The project in considered today of a major importance in French tunneling and geotechnical profession, involving almost all the major construction and engineering company, with a peak activity involving 22 tunneling machines for the whole project.

Past meeting

BTSYM March 2025 Lecture: Best practice sustainability frameworks for improving better outcomes for tunnels

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

INTERNATIONAL GEOSYNTHETICS SOCIETY

www.geosyntheticssociety.org

News

GeoAsia8 Keynote Lectures Revealed April 3, 2025

Eminent experts from around the world will be sharing their unmissable perspectives at the upcoming GeoAsia8 conference. The 8th Asian Conference on Geosynthetics takes place **Read More »**

Become A Founding Member Of IGS Premium Membership April 7, 2025

Become an inaugural member of the IGS's exciting new opportunity for Corporate Members. Introduced in January, this year, IGS Premium Corporate Membership is the ideal **Read More »**

IGS Foundation Praised On 5th Anniversary April 11, 2025

Tributes have been paid to the work and impact of the IGS Foundation (IGSF) as it celebrates five years of supporting geosynthetics education. Established in **Read More »**

North America Launches First 'IGS Student Club' April 14, 2025

A new student society model to place the IGS at the heart of learning has launched in California. Known as the International Geosynthetics Society at **Read More »**

Second Richard Bathurst Lecturer Revealed April 15, 2025

A lecture series honoring groundbreaking practitioners in soil reinforcement geosynthetics has named Pietro Rimoldi as its next speaker. The Richard Bathurst Lecture was established to **Read More »**

IGS Panama Shares Revitalization Plans April 16, 2025

Celebrating more than a decade championing geosynthetics in the region, a refreshed IGS Panama has set out bold commitments for the year ahead. Here, IGS **Read More »**

Apply Now For GeoAsia8 Travel Grant April 22, 2025

IGS Young Members are being urged to apply for a travel grant supporting their attendance at the forthcoming GeoAsia8 conference. The 8th Asian Conference on **Read More »**

IGS Launches 'JP Giroud Legacy' Resource April 22, 2025

The key works and achievements of geosynthetics' most pioneering practitioner are now easily accessible to all with the launch of the IGS's Giroud Legacy Project. **Read More »**

News
https://www.britishgeotech.org/news

Dr John Perry to give a Keynote Lecture at Earthworks 2025 Conference 08.04.2025

The BGA is pleased to announce that Dr John Perry will give a Keynote Lecture at our Earthworks 2025 Conference in September. The title of his lecture is Science, engineering and the development of modern earthworks design and construction.

The May 2025 issue of Ground Engineering is available on line 19.04.2025

The May 2025 issue of Ground Engineering is available on line. Online access to Ground Engineering (GE) is included in BGA subscriptions

Rodney Bridle to give a Keynote Lecture at Earthworks 2025 Conference 26.04.2025

The BGA is pleased to announce that Rodney Bridle will give a Keynote Lecture at our Earthworks 2025 Conference in September. The title of his lecture is Earth Dam Engineering – past, present and future.

Call for submissions – BGA annual conference young engineers' poster competition 2025 26.04.2025

BGA Annual conference 2025 – calling for poster submissions for the Young Engineers' Poster Competition. A prize of £150 is awarded. Deadline for submissions is Monday 16th June 2025.

News
www.geoinstitute.org/news

Important Update: New Guidelines for DIGGS CodeType References

Created: 22 Apr 2025

CodeType properties and code list dictionaries serve to manage controlled vocabularies and are foundational elements of the DIGGS standard. To improve both interoperability and flexibility across geotechnical data exchange, the DIGGS Team is pleased to announce updated guidelines for referencing code list dictionaries in DIGGS instances. These changes address key feedback from the 2025 DIGGS Code Jam Challenge.

Call for Presentation Abstracts for the 10th Annual Live Streaming Web Conference on December 8-12, 2025

Created: 30 Apr 2025

The Geo-Institute Soil Improvement Committee (SIC) is pleased to announce a Call for Presentation Abstracts for the 10th Annual Live Streaming Web-Conference to be held 8 to 12 December 2025. During the web-conference week, ten technical sessions will be run for approximately 2 hours (Monday – Friday from 11 AM – 1 PM EST and 2 PM – 4 PM EST). Based on guidance from the G-I, the session is envisioned to comprise five presentations with 20 minutes per presentation, with 20 minutes allotted for panel Q&A. The SIC plans to submit a proposal for one session; this Call for Presentation Abstracts will allow the committee leadership to review and select presentations to provide the most compelling session that will attract our G-I member audience. Previous web conference work and a survey of Geo-Institute members has demonstrated a continued interest in case histories related to the ground improvement field; this year we want to try and focus the case histories on transportation and infrastructure-related projects. Please consider preparing an abstract for a presentation on your work – there are bound to be ample infrastructure case histories on both proven and novel application of soil improvement technologies within our industry worthy of showcasing. Submissions should include the proposed title, an abstract of approximately 300 words describing the technical presentation, a separate speaker biography, speaker affiliation, and contact information. Authors of selected abstracts will be asked to prepare slides for the presentations. No technical accompanying paper is required.

Please send your abstract to Chris Woods at ***chris@densification.com*** by 13 June 2025.

74th Geomechanics Colloquium
Salzburg, Austria, 9-10 October 2025

Survey to explore potential differences between generations in geotechnical engineering and neighbouring disciplines

Charting the generational gap in the geo-disciplines: An online survey

Dear colleague,

Have you ever wondered whether your older or younger colleagues approach work differently than you? This online survey explores generational differences in the geo-disciplines with respect to technology, values, work habits and more, to learn lessons for the future. Share your experiences today by following this link:

Link: https://forms.office.com/e/zbV9tvqhQ7

The survey takes about 15 minutes and results will be anonymized.

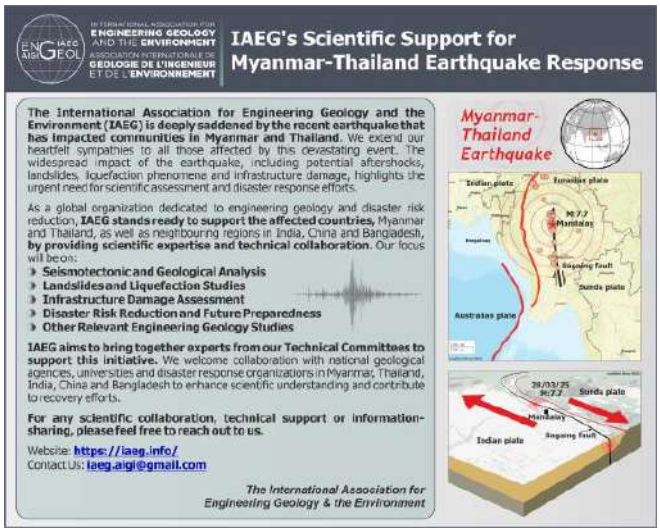
Please answer as many questions as you like, but be sure to hit the "submit" button at the very end!

Please share the link within your relevant network. We welcome professionals from all geo-related disciplines, including, but not limited to, geotechnical engineering, engineering geology, and mining engineering. Your input will help turn speculations into solid facts!

This survey is part of the "Generational Dialogue in Geotechnics" session at the Geomechanics Colloquium 2025 (October 9-10, Salzburg – event details). Survey participants can also receive the results via email.

Thank you for contributing to this important discussion!

The survey organizers. (Alexander Kluckner, Georg Erharter, Andreas-Nizar Granitzer, Bettina Mair, Suzanne Lacasse)



ΘΕΣΕΙΣ
ΓΙΑ ΓΕΩΤΕΧΝΙΚΟΥΣ
ΜΗΧΑΝΙΚΟΥΣ

PhD position within reuse of stabilised excavated soil (279952)
Norwegian University of Life Sciences (NMBU)

Faculty of Environmental Sciences and Natural Resource Management (MINA)
Duration: 3 years, starting in 2025

NMBU is hiring a PhD candidate for the project "Don't Waste", funded by the Research Council of Norway (2025–2028), in close collaboration with NGI. The research will explore the properties of stabilised excavated soil and assess its reuse in construction, landscaping, barriers, and aggregates.

Join us to advance sustainable solutions for soil reuse.

Apply here: **https://lnkd.in/dbqZzvbk**

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

IPA Seminar on Press-in Technology, 4th April 2025, Tunis, Tunisia, https://www.press-in.org/en

ROCSCIENCE INTERNATIONAL CONFERENCE 2025, April 6-8, 2025, Sydney, Australia, www.rocscience.com/events/rocscience-international-conference-2025

4th International Conference on TRANSDISCIPLINARY MULTISPECTRAL MODELLING AND COOPERATION FOR THE PRESERVATION OF CULTURAL HERITAGE Addressing World Challenges, 7-9 April 2025, Athens, Greece, https://www.tmm-ch.com

International Conference on Advances in Structural And Geotechnical Engineering (ICASGE'25), 14 - 17 April 2025, Hurghada, Egypt https://icasge.conferences.ekb.eg

Ground Engineering Piling and Foundations 2025, 22 April 2025, Lonfon, United Kingdom https://piling.geplus.co.uk/GEPI2025/en/page/home

Shaping the World Beneath:
Fostering Sustainability, Innovation and Resilience in Geotechnics
5 - 6 May 2026, Jeddah, Saudi Arabia
https://geotechnicalinnovationconference.com

Event Overview

Following a highly successful launch edition, the 2nd International Geotechnical Innovation Conference (IGIC 2025), will continue to serve as a key facilitator of the Middle East's and primarily Saudi Arabia's ambitious giga projects, by enabling successful construction in the region's highly challenging desert soil. From the region's biggest construction projects, recent metro projects, bridges, tunnels and city development works, this premier gathering will address the myriad of underlying construction challenges via keynote presentations and latest case studies by world-leading gurus in geotechnical engineering.

Led by a core committee of geotechnical experts from MENA,

IGIC is the region's only geotechnical conference for the industry, by the industry. The platform offers unparalleled opportunities to build strategic partnerships and collaborations with project owners, governments and municipalities leading projects, contractors, consultants, academia as well as geotechnical machinery providers.

Conference Themes in Discussion

1. Sustainability in Geotechnical Engineering

Focus: Strategies to minimize environmental impact, conserve resources, and promote eco-friendly practices in geotechnical engineering.

- Sustainable Foundations: Reducing CO2 Emissions and Enhancing Efficiency.
- Minimizing Environmental Impact of Urban and Sensitive Area Foundation Works.
- Lifecycle Assessment of Foundations for Long-Term Environmental Impacts.
- Sustainable Material Alternatives: Use of Recycled Aggregates and Green Cement.
- Coastal Protection and Erosion Control Strategies.
- Geotechnical Solutions for Climate-Resilient Infrastructure.

2. Innovation in Geotechnical Engineering and Soil Improvement Solutions

Focus: Cutting-edge methods and materials to improve soil and foundation performance under diverse environmental and structural conditions.

- Strengthening and Reusing Existing Foundations.
- Ground Stabilization Techniques for Extreme Environments (e.g., deserts, floodprone areas).
- Integration of Advanced Geosynthetics in Foundation Solutions.
- Bio-Based and Smart Materials for Adaptive Soil and Foundation Solutions.
- Innovative Geotechnical Construction Materials: Fiber-reinforced soils, nanomaterials, lightweight fills.

3. Geotechnical Resilience in Design and Practice

Focus: Enhancing infrastructure adaptability, durability, and recovery capacity in response to natural and man-made disasters.

- Designing Resilient Foundations and Infrastructure for Extreme Events.
- Adaptive Geotechnical Solutions for Post-Disaster Recovery and Reconstruction.
- Enhancing Soil and Foundation Performance under Dynamic and Cyclic Loading.
- Strategies for Improving Resilience to Seismic, Flooding, and Climate-Induced Risks.
- Monitoring and Feedback Systems for Resilient Geotechnical Systems.

4. Future Trends & Geotechnical Construction 4.0

Focus: Leveraging emerging technologies to optimize construction processes and improve design, monitoring, and efficiency in geotechnics.

- Building Information Modeling (BIM) for Geotechnical Projects.
- Automation and 3D Printing in Geotechnical Applications..
- Digital Twinning in Geotechnics.
- Digital Transformation in Foundation Design and Monitoring.
- Remote Sensing and Real-Time Monitoring in Geotechnical Engineering.
- Leveraging IoT and Big Data for Geotechnical Site Characterization.

5. Geotechnical Resilience in Design and Practice

Focus: Advanced computational methods to analyze and predict soil and structure behaviors under varied conditions.

- Finite Element and Finite Difference Methods for Complex Geotechnical Problems.
- Modeling Soil-Structure Interaction for Large-Scale Projects.
- Computational Geomechanics for Seismic and Dynamic Analysis.
- Integration of Numerical Models with Field Monitoring Data for Validation.
- Advanced Soil Models: Hardening Soil, Mohr-Coulomb, Cam-Clay, Barcelona Basic Model (BBM), Hypoplasticity Models.

6. Geohazards And Risk Mitigation

Focus: Identifying, monitoring, and mitigating geotechnical risksassociated with natural hazards and high-risk areas.

- Landslide Prediction, Monitoring, and Stabilization Techniques.
- Managing Risks of Soil Liquefaction in Seismic Zones.
- Geotechnical Solutions for Volcanic, Tsunami, and Earthquake-Prone Areas.
- Early Warning Systems for Geohazards Using Remote Sensing and IoT.
- Addressing Urban Flooding, Ground Subsidence, and Other High-Risk Areas.

7. Expanding Geotechnical Applications and Geothermal Energy

Focus: Exploring new and specialized applications of geotechnical engineering, including renewable energy and urban innovations.

- Geotechnics for Offshore Projects and Renewable Energy.
- Foundations and Solutions for Geothermal Energy Extraction.
- Urban Geotechnics: Challenges of Underground Space Development in Mega-Cities.
- Managing Ground Subsidence and Vertical Expansion in Urban Areas.

8. Innovating Risk Sharing and Aligning with Sustainable Standards

Focus: Sharing successful practices, challenges, and breakthroughs from regional geotechnical projects in MENA.

- Highlighting Geotechnical Engineering Projects in Infrastructure, Renewable Energy, and Urban Expansion.
- Lessons Learned and Innovations from Regional Projects.
- Offshore Geotechnics for Marine Structures in the MENA Region.

9. Notable Projects and Case Studies from Mena

Focus: Developing frameworks for risk management, ethical practices, and adherence to sustainability standards in geotechnics.

- Risk Mitigation Strategies for Complex Geotechnical Challenges.
- Integration of ISO 14001 and Similar Environmental Standards in Geotechnical Projects.
- Risk Sharing Frameworks for High-Stakes Projects.
- Legal and Ethical Considerations in Geotechnical Engineering Practice.

10. Workforce Development and Academia-Industry Collaboration

- Training, Education, and Cross-Disciplinary Collaboration in Geotechnical Engineering.
- Strategies for Enhancing Diversity and Inclusion in Geotechnical Workforces.
- Establishing Partnerships for Research and Development in Geotechnical Engineering.
- Collaborative Platforms for Knowledge Sharing and Skill Building.
- Industry-Supported Internships and Fellowships for Aspiring Geotechnical Engineers.
- Promoting Applied Research to Address Real-World Challenges.

Conference Agenda

Innovative Soil Improvement and Foundation Solutions

- Advanced ground improvement techniques for desert, semi-arid and coastal regions
- Novel deep foundation designs for high-rise structures
- Underpinning techniques for historical and sensitive structures
- Techniques for managing problematic soils in the Gulf
- Soil foundation structure interaction

Automation and Digital Twinning in Geotechnics

- Integration of Building Information Modeling (BIM) in geotechnical design
- Real-time simulations for excavation and retaining systems
- Digital twinning for underground constructions and tunnelling
- Benefits and challenges of adopting digital twinning in geotechnical projects

Key Areas of Focus

Focus Project Categories

Tall Buildings & Skyscrapers

- Tall, super tall and mega tall buildings
- Megacities

Transportation Infrastructures

- Bridges and highways
- Road and rail infrastructures

Underground, Civil Infrastructure and Deep Excavation Projects

- Underground pipeline network for oil, gas, water and sewage
- Underground infrastructure for telecommunications
- Tunnels and subways

Energy, Water and Coastal Infrastructure Projects

- Mine development
- Dam construction
- Man-made Islands
- Near-shore Oil & Gas projects

CONTACT US

Serah Ben
Conference Director
serah@gmevents.ae
+971-52 793 3292

Organized by Creative CONNECT

Al-Abyad Street, Al-Sharafiya District, 7014, Riyadh, KSA
Mail: info@creativeconnectionevents.com
Phone: +966 58 382 9465
Phone: +966 11 440 0424

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

Journées Francophones de Mécanique des Roches et Géologie de l'Ingénieur
14-15 mai 2025, Villeneuve d'Ascq, France

Les comités francophones de mécanique des roches et de géologie de l'ingénieur (CFMR, CFGI, RockEnGeo.be, Ingeokring et Géotechnique Suisse) se sont associés pour préparer une séance technique de deux jours, autour de la résilience des infrastructures face au changement climatique. Nous espérons que les visions croisées proposées autour des différents objets d'étude seront riches d'enseignements et d'échanges.

Session 1 : Approche théorique des effets hydriques dans les massifs rocheux

Session 2 : Cavités souterraines

Session 3 : Falaises

Session 4 : Haute montagne

Session 5 : Itinéraire

Contact

Pour les questions relatives à l'organisation: rima.ghazal@arteliagroup.com

Pour les questions relatives à l'inscription/ paiement: info@rockengeo.be

ISRM Workshop on Soft Rocks (ISRM-WSR2025), 15-16 May 2025, Porto, Portugal, Manuel Carvalho (manuel@fe.up.pt), Danting Hu (dantinghu@126.com)

T28th ICOLD Congress & 93rd Annual Meeting "Common Challenges, Shared Future, Better Dams", May 16th to 23rd, 2025, Chengdu, China, www.icold-cigb2025.com

GEOTECHNICS REIMAGINED, May 21-23, 2025, Bruges, Belgium, https://dfi-events.org/dfi-effc25

17th International Congress of the Geological Society of Greece, Session "The 2024-2025 Santorini volcano-seismic crisis: Origin, Impacts and Consequences", 28-31 May, 2025 Mytilene, Lesvos, Greece, https://ege2025lesvos.gr

DTU TC101 workshop Expanding the boundaries of conventional laboratory testing, 2nd-4th June 2025, Copenhagen, Denmark, www.conferencemanager.dk/expandingtheboundariesofconventionallaboratorytesting

2nd International Symposium on GeoTest Sites (2nd ISGTS), 5-6 June 2025, Tampere, Finland https://events.tuni.fi/isgts

ISFOG 2025 5th International Symposium on Frontiers in Offshore Geotechnics, June 9-13, 2025, Nantes, France, https://isfog2025.univ-gustave-eiffel.fr

GeoAsia - 8th Asian Conference on Geosynthetics, 10-13 June 2025, Brisbane, Australia, https://geoasia8.org

EGRWSE-2025 6th International Conference on Environmental Geotechnology, Recycled Waste Materials and Sustainable Engineering, June 11-14, 2025, Vigo, Spain, https://egrwse2025.webs.uvigo.es/

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, https://eurock2025.com

3rd International Conference on Energy Geotechnics – Implementing the Energy Transition, 17-20 June 2025, Paris, France, Kamelia Atefi-Monfared, catefi@yorku.ca

The Fourth Pan-American Conference on Unsaturated Soils, June 22 - 25, 2025, Ottawa, Ontario, Canada www.panamunsat2025.ca

5ICGE & 3ICESE 5th International Conference on Geotechnical Engineering-Iraq & 3rd International Conference on En-

gineering Science & Energy, 1–3 July 2025, 3 July 2025, Komar University, Sulymaniyah, Iraq, Saint-Petersburg, Russia, https://icge.tech

6th International Conference GEE2025: Charting the path toward the future Geotechnical Engineering Education, July 2-4 2025, Nancy, France, https://gee2025.sciencesconf.org/

AFRICA 2025 The Fifth International Conference and Exhibition on Water Storage and Hydropower Development for Africa, 8-10 July 2025, Accra, Ghana www.hydropower-dams.com

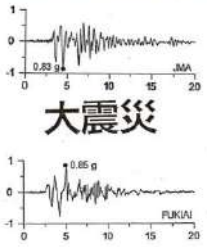
ISGSR2025 9th International Symposium for Geotechnical Safety and Risk, 24th – 27th August 2025, Oslo, Norway, www.isgsr2025.com

Giz2025.org 6th International Conference on GIS and Geoinformation Zoning for Disaster Mitigation (GIZ), August 28-30, Almaty, Kazakhstan, https://giz2025.org

ETH Zürich
Dept. of Civil, Environmental and Geomatic Engineering
Prof. Ioannis Anastasopoulos

National Technical University of Athens
School of Civil Engineering
Prof. G. Gazetas

On–site Short Course on
Geotechnical Earthquake Engineering
Kobe and Tokyo, Japan



30 August – 7 September 2025

Dr. Hiroyuki Kimata
High Pressure Gas Safety Institute of Japan
高圧ガス保安協会

Prof. Hisakazu SAKAI
Hosei University
法政大学 HOSEI University

We are organizing once more our On-site Short Course on Geotechnical Earthquake Engineering. This year marks 30 years from the 1995 Kobe earthquake, and our Japanese colleagues are organizing the 30th Anniversary Memorial Workshop for the Great Hanshin Awaji (Kobe) Earthquake, which will take place in Kobe on September 1, 2025, and in which we will also have the opportunity to participate.

The On-site Short Course will take place in Kobe & Tokyo, Japan, from August 30 to September 7, 2025. It is the outcome of over 25 years of development, starting as a field trip in 1999 and taking place almost every year since then, being mainly offered to graduate–level students of the National Technical University of Athens. The course will offer graduate-level students and early career researchers a unique opportunity to study real case histories in the field, learning from the Japanese experience.

Please find attached a tentative detailed schedule of short course. Interested participants are invited to submit their application along with a CV via return email (ixa@ethz.ch) as soon as possible, but no later than March 31, 2025. The cost of the short course is CHF 1280 (in a double room), or 1480 (in a single room). This includes the hotels (6 nights in total, incldiuing breakfast), bus and tour guide, and the Shinkansen train from Kobe to Tokyo. No fees are charged for the participants. In your email, please indicate whether you would like a double or a single room, and in the case of a double, with whom you will be sharing.

Not included are the air tickets and the 30th Anniversary Memorial Workshop, which will be paid separately to the organizers in Japan. The detailed schedule includes also the flights that participants from Zurich will be taking. International participants may choose any flight they wish, but if they manage to get a flight connection from Dubai, this would allow them to arrive the same time with the Zurich group. If this is not possible, we will meet directly in Kobe on Sunday evening.

We have limited availability, and we will probably not be able to accommodate all requests. We thank you in advance for your understanding.

Best regards,
I. Anastasopoulos

UNSAT2025 5th European Conference on Unsaturated Soils, 1 to 3 September 2025, Lisbon, Portugal, https://eunsat2025.tecnico.ulisboa.pt

ISP8 Symposium International pour le 70ème anniversaire du pressiomètre / International Symposium for the 70th Anniversary of the Pressuremeter, 2nd to 5th of September 2025, LUXEMBOURG, https://isp8-pressio2025.com

TKZ2025 XXI Technical Dam Control International Conference, 09-12 September 2025, Chorzów, Poland https://tkz.is.pw.edu.pl/en/

EYGEC 29th European Young Geotechnical Engineers Conference, 9-12 September, 2025, Rijeka, Croatia, https://eygec2025.uniri.hr

EUROGEO Technical Challenges and Environmental Imperatives for the 21st Century, 15-18 September 2025, Lille, France, https://eurogeo8.org

TRANSOILCOLD 2025 7th International Symposium on Transportation Soil Engineering in Cold Regions, September 17-20, 2025, Incheon, Korea, www.transoilcold2025.org

2025 AIGTAS IWLSC 3rd International Workshop on Landslides in Sensitive Clays, September 28th to October 2nd, 2025, Quebec, Canada www.iwlsc2025.ca

GROUND ENGINEERING GEOTECH 2925 Where innovation meets opportunity, 2 October 2025, London, United Kingdom https://www.geplus.co.uk/news/ground-engineering-to-launch-geotech-2025-conference-where-innovation-meets-opportunity-16-01-2025

GEOTECH ASIA 2025 - GEOVADIS: The Future of Geotechnical Engineering, October 7th to 10th, 2025, Goa, India, https://www.geotechasia.org

*f*OMLIG3 FLORENCE 2025 Third Workshop on the Future of Machine Learning in Geotechnics "Ethics and intelligences for a geotechnical Renaissance", October 15-17, 2025, Florence, Italy https://fomlig2025.com

Urban GeoEngineering 5th AsRTC6 "Urban GeoEngineering" Symposium, 23rd & 24th of October 2025, Taipei, Taiwan, www.asrtc6urbangeoengineering2025.com/index.html

6ο Πανελλήνιο Συνέδριο Αντισεισμικής Μηχανικής και Τεχνικής Σεισμολογίας (*6ΠΣΑΜΤΣ*), 30, 31 Οκτωβρίου και 1 Νοεμβρίου 2025, https://6psamts.eltam.org

MedGU 10–13 NOV. 2025 ATHENS, GREECE | MEDITERRANEAN GEOSCIENCES UNION 5TH ANNUAL MEETING

https://2025.medgu.org/index.php

It is a pleasure and an honor to invite you to attend the MedGU-25, which will be held in-person and online on 10–13 November 2025 in Athens, Greece. Researchers from all fields of the geosciences from all over the world are invited to present and discuss their newest original work.

After the remarkable successes of the 1st CAJG, 2nd CAJG and 3rd CAJG, it became obvious that there was a need to create a larger and more comprehensive international geoscience conference, one that would bring together even more participants from all over the world and cover a wide range of topics from all the disciplines of the Earth and planetary sciences.

With this objective in mind and as a continuation of the overwhelming success of MedGU-21 (Istanbul, Türkiye), MedGU-22 (Marrakech, Morocco), MedGU-23 (Istanbul, Türkiye), and MedGU-24 (Barcelona/Catalonia, Spain) which have attracted a great deal of interest with over 6,000 abstract submissions from 95 countries, the MedGU Annual Meeting will continue to be organized in 2025 to provide a forum where scientists from the Mediterranean region and all over the world, especially researchers at the early stages of their careers, can be informed about the latest geosciences studies and discuss their latest unpublished findings with experts from the wide-ranging fields of Earth and planetary sciences.

During MedGU-25 which will be hosted by the National and Kapodistrian University of Athens, a number of prominent speakers will be invited to give keynotes. Moreover, we are planning workshops, a social program, and a field trip, where participants can take a little time out to explore the wonders of the geological sites of Greece.

As with the previous MedGU Proceedings, the latest research findings at MedGU-25 will be published in the conference proceedings by Springer (indexed in Scopus/SCImago) and in some Special Issues, with a clear mission to encourage greater scientific cooperation and to open doors to new and enriching collaborations between geoscientists on the opposite shores of the Mediterranean and from all over the world.

MedGU-25 is looking forward to cordially welcoming you in Athens... Your participation in person or virtually will support MedGU's mission of ensuring a sustainable future for humanity in the region and for the planet.

Conference Tracks

- Track 1. Atmospheric Sciences, Meteorology, Climatology, Oceanography
- Track 2. Biogeochemistry, Geobiology, Geoecology, Geoagronomy
- Track 3. Earthquake Seismology and Geodesy
- Track 4. Environmental Earth Sciences
- Track 5. Applied & Theoretical Geophysics
- Track 6. Geo-Informatics and Remote Sensing
- Track 7. Geochemistry, Mineralogy, Petrology, Volcanology, Planetology
- Track 8. Geological Engineering, Geotechnical Engineering, Geomechanics, Mining Sciences
- Track 9. Geomorphology, Geography, Soil Science, Glaciology, Geoarchaeology, Geoheritage
- Track 10. Hydrology, Hydrogeology, Hydrochemistry
- Track 11. Petroleum and Energy Sciences and Engineering
- Track 12. Sedimentology, Stratigraphy, Paleontology, Geochronology, Marine Geosciences, Historical Geology
- Track 13. Structural Geology, Tectonics and Geodynamics, Petroleum Geology
- Track 14. Other Related Topics
- Track 15 (Special Session). Understanding of Mineral Resources from Advancing Models of Ore-Forming Systems
- Track 16 (Special Session). Landslides: Processes, Hazard and Risk
- Track 17 (Special Session). Land Subsidence: Triggers and Monitoring
- Track 18 (Special Session). Mountains of the Mediterranean: Glaciers, Climate, and Human-Environment Interactions
- Track 19 (Special Session). Innovative Methodologies in Geohazard Monitoring and Assessment: UASs, LiDAR, AI, and Geodetic Tools
- Track 20 (Special Session). Urban Climate Systems: Drivers, Impacts, and Response Strategies
- Track 21 (Special Session). From Data to Decisions: Artificial Intelligence Approaches in Natural Hazard Science

ΕΤΕΠΑΜ

7ο Συνέδριο Αναστηλώσεων
13-15 Νοεμβρίου 2025, Αθήνα
www.etepam.gr/7ο-synedrio-anastiloseon

Η ΕΤΕΠΑΜ διοργανώνει το **7ο Πανελλήνιο Συνέδριο Αναστηλώσεων που θα διεξαχθεί στην Αθήνα, στο Πολιτι-**

στικό Κέντρο του Μουσείου Μπενάκη (Πειραιώς 138), στις 13-15 Νοεμβρίου 2025.

Το Συνέδριο απευθύνεται σε επιστήμονες που προέρχονται από τους χώρους των φυσικών επιστημών και της τεχνολογίας και συνεισφέρουν στην προστασία και αποκατάσταση των μνημείων.

Αντικείμενο – Θεματολογία

Στο αντικείμενο του Συνεδρίου εμπίπτουν τα σχετικά με την Αναστήλωση των ιστορικών κτισμάτων (και των λειψάνων τους) ζητήματα, που αφορούν

α) στη φιλοσοφία και μεθοδολογία των επεμβάσεων,
β) στη σεισμική επικινδυνότητα και λοιπούς παράγοντες τρωτότητας των μνημείων,
γ) στην τεχνολογική έρευνα (τεκμηρίωση, τεχνικές, υλικά κλπ.) και εφαρμογή
δ) στην ανάδειξη μνημείων και αρχαιολογικών χώρων.

Η διάρκεια του συνεδρίου θα είναι τριήμερη και μία από τις συνεδρίες θα αφιερωθεί στο ειδικό θέμα **«Μνημεία και κλιματική αλλαγή»**.

Στόχος της διοργάνωσης είναι η ουσιαστική αλληλοενημέρωση και ανταλλαγή απόψεων μεταξύ συνέδρων και εισηγητών και η πρόκληση ενός γόνιμου διεπιστημονικού διαλόγου, που θα συνεισφέρει στην προώθηση (προς όλους τους φορείς υλοποίησης και προστασίας στη χώρα μας) της επιστημονικής προσέγγισης των θεμάτων προστασίας, αναστήλωσης, αποκατάστασης, ανάδειξης των μνημείων, καθώς και στη λήψη μέσων πρόληψης έναντι φυσικών καταστροφών.

Οι συνάδελφοι που επιθυμούν μπορούν να συμμετάσχουν με ανακοίνωση. Οι ανακοινώσεις που θα παρουσιαστούν πρέπει να είναι πρωτότυπες και να αποτελούν ουσιαστική συμβολή στο αντικείμενο, εκθέτοντας – στην περίπτωση των εφαρμογών – ολοκληρωμένη την αναστηλωτική προβληματική του συμμετέχοντα και – στην περίπτωση της έρευνας – την άμεση συσχέτισή της με τα αναστηλωτικά ζητήματα. Ανακοινώσεις με αντικείμενο την απλή απαρίθμηση εργασιών ή με αμιγή προσέγγιση ιστορίας της αρχιτεκτονικής δεν εμπίπτουν στην θεματολογία. Η γλώσσα του Συνεδρίου είναι η Ελληνική. Μπορούν να γίνουν δεκτές ανακοινώσεις στην Αγγλική, αλλά δε θα υπάρξει δυνατότητα μετάφρασης. Η διάρκεια των ανακοινώσεων δεν θα υπερβαίνει τα 15 λεπτά. Κάθε σύνεδρος μπορεί να παρουσιάσει μέχρι δύο ανακοινώσεις και να συμμετέχει σε τρεις ανακοινώσεις συνολικά.

Επικοινωνία – πληροφορίες:

e mail: **7etepam.conference@gmail.com**
τηλ: 6972082970 και 6932479368 για την Αθήνα
6980191672 για τη Θεσσαλονίκη

ORFEUS+EFEHR+EMSC (EPOS Seismology) & Geo-INQUIRE Workshop 2025
24-27 November, Athens, Greece

Venue: the Propylaea building of the National and Kapodistrian University of Athens (closest underground station "Panepistimio")

Preliminary programme at a glance: https://u.ethz.ch/3qNhF

Note: Geo-INQUIRE is funded by the European Commission under project number 101058518 within the HORIZON-INFRA-2021-SERV-01 call. We promote equality, diversity, and inclusion under the advice of the Equality, Diversity and Inclusion Panel at all events organized as part of Geo-INQUIRE. In particular, **we support registrations from women, early career scientists and people from widening countries**. Terms and Conditions for participants in Geo-INQUIRE activities: https://www.geo-inquire.eu/about/terms-and-conditions

https://docs.google.com/forms/d/e/1FAIpQLSf-LXXy8X-jiEtaCaI_n2VIp7QcM-71TJAY9ZCsPlt8SVNM1Q/viewform

17th International Conference on Geotechnical Engineering 8th International Symposium on Geohazards, December 4-5, 2025, Lahore, Pakistan, https://17icge-8isg.com

Pan Mediterranean Geotechnical Engineering Conference
25 - 28 March 2026, Phoenicia Beirut IHG, Lebanon
https://pmgec-leb.com

Join us for the **Inaugural Pan Mediterranean Geotechnical Engineering Conference**, a groundbreaking gathering of professionals, researchers, and industry leaders from across the Mediterranean region. Hosted in the vibrant city of Beirut, Lebanon, between 25 and 28 March 2026. This conference marks the beginning of an exciting journey to address the pressing geotechnical challenges faced by countries surrounding the Mediterranean Sea.

The Inaugural Conference Theme 2026

Bridging Borders: Geotechnical Challenges and Innovations Across the Mediterranean

With this theme, we highlight the unique geotechnical challenges faced by countries surrounding the Mediterranean Sea while emphasizing collaboration, knowledge exchange, and innovative solutions. This theme also reflects the conference's location in Beirut, a city known for its historical significance and strategic position as a cultural and economic hub in the region.

It aligns well with the diverse backgrounds and expertise of attendees from Mediterranean countries, fostering discussions on common issues such as seismic risks, coastal engineering, infrastructure development, and sustainable construction practices. Additionally, it underscores the importance of cross-border cooperation in addressing shared geotechnical challenges and advancing the field collectively.

This theme sets the stage for insightful discussions, networking opportunities, and knowledge sharing among geotechnical engineering professionals, researchers, and industry stakeholders attending the conference in Beirut.

Topics

- Ground Improvement for Challenging Soils
- Geotechnical Hazards and Risk Assessment
- Soil Structure Interaction
- Advancements in Geotechnical Investigation and In Situ Testing
- Geosynthetics and Reinforced Soil Structures
- Geotechnical Challenges in Offshore and Marine Designs
- Energy Geotechnics
- Earthquake Engineering and Seismic Design Considerations
- Environmental Geotechnics and Sustainable Design Practices
- Geotechnical Monitoring and Instrumentation for Infrastructure Projects
- Geo Education
- Transportation and Geotechnics
- Engineering Geology
- Artificial Intelligence in Geotechnics

Organizer

LGES Lebanese Geotechnical Engineering Society, contact@lges.org, www.lges.org, Follow us on LinkedIn, Send us a message

Event Management Company

iNFOMED, infomed@infomedweb.com, www.infomedweb.com, Tel. +961 1 510881 / 2 / 3, +961 71 103123

https://www.youtube.com/watch?v=d9GVCuPeXSU

LANDSLIDES 2026 Landslide Geo-Education and Risk (LaGER), 27 April - 1 May 2026, Queenstown, New Zealand http://landsliderisk.nz

15th International Conference "Modern Building Materials, Structures and Techniques", May 12-15, 2026, Vilnius, Lithuania, https://vilniustech.lt/332107

ITA-AITES WTC 2026 Montréal

https://wtc2026.ca

On behalf of the Canadian Tunnelling Association and the 2026 World Tunnel Congress Organizing Committee, I'm pleased to extend my warmest greetings and invite you to take part in this not-to-be-missed event, which will take place from May 15 to 21, 2026, in Montreal, Quebec, Canada.

Montreal is an island at the confluence of the St. Lawrence and Ottawa rivers. Steeped in history yet at the same time a dynamic technological crossroads, Montreal holds THE top spot as a host city for international congresses in America, for many reasons: its legendary safety, its cultural dynamism (more than 30 languages are spoken here), its world-renowned gastronomy, not to mention underground Montreal and its 33 km-long pedestrian network.

The event will be held at the Palais des congrès de Montréal, one of the world's most renowned convention and exhibition centers, thanks to its event technologies, ultramodern spaces and exceptional organization services. The site features a vast exhibition area showcasing new technologies, original products and services related to underground construction. The exhibition, technical program and state-of-the-art conference setting will encourage interaction and the exchange of ideas.

The conference theme, "Connecting communities through underground infrastructure", addresses the vital role the tunnelling industry plays in connecting our communities through underground infrastructure. This enables the industry to build underground networks of transportation, water and sanitation, utilities and energy that cross, connect and unite cities, regions and continents.

WTC 2026 aims to bring together our international community of tunneling practitioners to share their experience and knowledge to make our projects safer, more economical, more resilient and more sustainable. It will not only generate considerable benefits for the tunnelling industry in Montreal, the province of Quebec and Canada as a whole, but will also promote Canadian expertise.

The scientific program, technical sessions and social activities will enable delegates to participate in exchanges, acquire new knowledge and establish new contacts with professionals from all over the world.

The topics for the WTC2026

- Contractual Practices, Insurance and Risk Management
- Planning and Use of Underground Space
- Site Investigation and Ground Characterization
- Instrumentation, Monitoring and Remote Sensing
- Artificial Intelligence and Machine Learning
- Conventional Tunnelling in Challenging Conditions
- Sequential Excavation and NATM
- Mechanized Tunnelling in Challenging Conditions
- Immersed Tunnels
- Caverns and Power Houses
- Microtunnelling
- Shaft Design
- Innovative Tunnelling
- Robotics and Automation
- Ground Support and Lining Design
- Grouting, Groundwater Control and Waterproofing
- Digital and Information Technology
- Operation, Inspection, Maintenance and Rehabilitation
- Safety in Tunnelling
- Equity, Diversity and Inclusion in Tunnelling

ICPMG 2026

Physical Modelling in Geotechnics
8–12 June 2026, ETH Zürich, Switzerland
https://tc104-issmge.com/icpmg-2026

Dear Colleagues and Friends,

You are warmly invited to the 11th International Conference on Physical Modelling in Geotechnics (ICMPG 2026), which will take place in ETH Zürich, Switzerland, 8–12 June 2026! The conference will take place on the ETH Zurich Hönggerberg Campus, which is located just 15 minutes (with a direct bus link) from Zurich city center.

ICPMG 2026 aims to provide a dynamic forum for academics, engineers, researchers, technicians and students, where the latest developments in modelling techniques, technologies, similitude laws, and all other aspects of physical modelling in geotechnics will be discussed.

The conference will offer an up-to-date overview of the latest developments in multi-scale physical modelling within the following general themes:

- New facilities, new equipment, and measuring techniques
- Scaling laws and fundamentals
- Resilient Geotechnical Infrastructure
- Sustainability in Geotechnical Systems
- Energy geo-structures and foundation systems
- Onshore and offshore foundation systems

Besides centrifuge modelling, studies based on 1g shake table and large scale testing are warmly welcome, as well as research that combines numerical and physical modelling.

We are looking forward to your active participation, and kindly ask you to forward the announcement to your networks.

Prof. Ioannis Anastasopoulos
Chair of ICPMG 2026, TC104

Contact

Conference Office
ETH Zurich
ICPMG 2026
Institute for Geotechnical Engineering
Stefano-Franscini-Platz 5
8093 Zurich, Switzerland

www.ethz.ch
ETH Zurich, Hönggerberg campus

Organising Committee
Prof. Ioannis Anastasopoulos
Chair of ICPMG 2026, TC 104
icpmg2026@ethz.ch

Conference Secretariat
Sonja Zwahlen
Phone +41 44 633 2535
Gabriela Laios
Phone +41 44 633 2525
icpmg2026@ethz.ch

8th International Young Geotechnical Engineers Conference - 8iYGEC, 11. - 14. June 2026, Graz, Austria, www.tugraz.at/institute/ibq/events/8iygec

21st International Conference on Soil Mechanics and Geotechnical Engineering Geotechnical Challenges in a Changing Environment, 14 – 19 June 2026, Vienna, Austria, www.icsmge2026.org/en

IGIC 3RD INTERNATIONAL GEOTECHNICAL INNOVATION CONFERENCE

https://geotechnicalinnovationconference.com

Conference Overview

As the Middle East, particularly Saudi Arabia continues to lead one of the world's most ambitious construction booms, the **2nd Annual International Geotechnical Innovation Conference (IGIC 2025)** emerged as a key enabler of the

region's drive for engineering excellence. Held from **5–6 May 2025 in Jeddah, Saudi Arabia,** IGIC 2025 brought together over 500 delegates and more than **40 industry-leading speakers** for two days of impactful dialogue and innovation.

IGIC 2025 was designed to support Saudi Arabia's and the broader Middle East's vision for transformative growth, anchored by giga-projects, megacities, high-rise buildings, integrated transport systems, underground structures, and land reclamation developments such as man-made islands. The conference addressed the critical role of geotechnical engineering in ensuring the safety, cost-efficiency, and sustainability of these infrastructure projects.

As the region's premier geotechnical engineering platform, IGIC 2025 delivered a dynamic program including two intensive workshops, ten keynote addresses, and more than ten technical sessions. These sessions explored cutting-edge advancements in:

- ✓ Innovative Soil Improvement and Foundation Solutions
- ✓ Automation and Digital Twinning in Geotechnics
- ✓ Remote Sensing and Monitoring in Geotechnical Engineering
- ✓ Artificial Intelligence in Geotechnics
- ✓ Sustainability in Geotechnical Engineering
- ✓ Geotechnical Industry 4.0 & Future Trends
- ✓ Training, Education, and International Collaboration

The forum also featured a **world-class exhibition** showcasing state-of-the-art geotechnical technologies, products, and services from leading global and regional companies.

IGIC 2025 served as a vital hub for knowledge exchange, strategic networking, and collaboration across public and private sectors, convening geotechnical and civil engineers, project owners, contractors, consultants, regulatory authorities, and academia seeking to stay ahead in a fast-evolving landscape.

Why Attend?

01. Listen to case studies from the Middle East for super tall buildings, metro projects and underground infrastructure projects

02. Address the critical gap in the design and construction of deep foundations in the Middle East region

03. Find out the perils and negative impact of over designing deep foundation projects

04. Learn more about green geotechnical construction techniques and solutions, and driving sustainability in foundation engineering

05. Find more about digital twinning and real-time simulations for underground constructions and excavations

06. Learn about the critical nature of soil-surface interactions in geotechnical design for deep foundation structures

07. Learn about advanced soil improvement techniques

08. Find out the future trends in geotechnics and the game-changing role of AI and 3D printing in ground improvement

09. Listen to innovative micro tunnelling technologies and techniques deployed for one of the most expansive underground tunnelling projects

Contact

Al-Abyad Street, Al-Sharafiya District, 7014, Riyadh, KSA
Tel. +966 58 382 9465
Email info@creativeconnectionevents.com

ISFMG 2026 12th International Symposium on Field Monitoring in Geomechanics, 06 -10 August 2026, Indian Institute of Technology Indore, India, https://sites.google.com/view/isfmg2026/home

International Conference on

Advances and Innovations in Soft Soil Engineering 2026

24-26 August 2026, Delft, Netherlands

As global land development expands into coastal regions, offshore reclamation areas, and wetlands, the geotechnical challenges posed by soft soils are becoming more critical. These soils, including highly sensitive clays, marine silty clays, organic soils, peats, loose sands, and dredged soils, are known for their high compressibility, water content, and complex mechanical properties, making construction projects in such areas problematic. To address these challenges, soft soil engineering is evolving with innovative technologies and approaches.

This conference, organised under the auspices of the ISSMGE Technical Committee 214 on "Foundation Engineering for Difficult Soft Soil Conditions", will showcase the latest developments in testing, modelling, monitoring and construction and improvement techniques for soft soils. It will provide a platform for researchers, engineers, and industry professionals to exchange expertise and discuss how these innovations can be applied to address modern construction challenges in soft soil environments.

Contact Information

Contact person: Stefano Muraro, s.muraro@tudelft.nl

X Latin American Congress on Rock Mechanics
26 - 28 Aug, 2026, Brsasilia, Brazil

Contact Person: Marcos Massao Futai, Brazilian Committe of Rock Mechanics

13 ICG - 13th International Conference on Geosynthetics (13 ICG), 13-17 September 2026, Montréal, Canada, www.13icg-montreal.org

Eurock 2026
Risk Management in Rock Engineering - an ISRM Regional Symposium
15-19 September 2026, Skopje, Republic North Macedonia

Contact Person Name
Prof. Milorad Jovanovski
Email jovanovski@gf.ukim.edu.mk

International Symposium Preservation of Monuments & Historic Sites, 16 – 18 September 2026, Athens, Greece https://tc301-athens.com

6th International Conference on Information Technology in Geo-Engineering JTC2 Conference, 13-16 October 2026, Graz, Austria, www.icitg2026.com

Slope Stability 2026

Slope for Safety Performance
an ISRM Specialized Conference
26 – 29 October 2026, Lima, Peru

Organizer: Sociedad Peruana de Geoingeniera (SPEG)

Contact Person Name: Antonio Samaniego and Luis Claudio Tejada Alvarez

Email asamaniego@srk.com.pe, geoingenieria@speg.org.pe

Telephone: +51999451060

Address: Grimaldo del Solar 875, Miraflores Lima -Peru

PBD-V Chile International Conference on Performance-Based Design in Earthquake Geotechnical Engineering, November 4th to 6th, 2026, Puerto Varas, Chile www.pbd-v-chile.com

14th Asian Rock Mechanics Symposium
Rock Mechanics for the Next Generation
–Innovations, Sustainability, and Resilience–
an ISRM Regional Symposium
22-26 November 2026, Fukuoka, Japan
www.ec-convention.com/ARMS14/

On behalf of the organizers, I would like to extend a warm welcome to the 14th Asian Rock Mechanics Symposium (ARMS14), which will be held in November 2026. This conference is a valuable opportunity to share the latest research findings and technological innovations in the field of rock mechanics in the Asian region, and to deepen exchanges among researchers and engineers. This is the third time Japan has hosted ARMS, following ARMS3 in Kyoto and ARMS8 in Sapporo. This time, ARMS14 has been selected as an official international symposium of the International Society for Rock Mechanics and Rock Engineering (ISRM).

The theme of the conference is "Rock Mechanics for the Next Generation ~ Innovations, Sustainability, and Resilience ~." This theme reflects our commitment to pursuing innovation, enhancing sustainability, and building resilience to address the next generation of challenges in rock engineering. This symposium will provide a platform to share the latest research findings and technologies, fostering new perspectives and collaborations. Additionally, we encourage the participation of young researchers through presentations and poster sessions, incorporating new viewpoints and ideas. We hope this will help the next generation of leaders grow and pave the way for the future of rock engineering.

Fukuoka, the host city, is known as an "international city" with strong ties to Asia, offering an attractive environment where history and modernity harmonize. During the symposium, in addition to academic discussions, you will have the opportunity to experience the nature and culture of Fukuoka, gaining further inspiration.

Finally, we hope that ARMS14 will be a significant opportunity to shape the future of the rock engineering field. We sincerely expect this international conference to be a starting point for next-generation research and technological innovation, contributing to new solutions for regional and international challenges.

Topics

Mitigation of Geo-hazards

Earthquakes and Rock Dynamics, Risk and Hazard Management, Disaster Mitigation, and Slope Stability

Environmental Issues

Global Warming, Carbon Dioxide Capture and Storage, Radioactive Waste Disposal, and THMC Coupling

Energy Resources

Mining Engineering, Petroleum Engineering, Geothermal Power Generation, and Reservoir Engineering

New Technologies and Fundamental Aspects

Rock Properties and Site Characterization, Geophysical Prospecting and Testing Methods, Tunnels and Underground Spaces, Maintenance and Life Cycle Costs, and Field Measurements and Back Analysis

Secretariat Office
Shinichiro NAKASHIMA, Secretary General
arms14.secretariat@rocknet-japan.org

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.

XIXth European Conference on Soil Mechanics and Geotechnical Engineering "Connecting Continents Through Geotechnical Innovations"
04-08 September 2028, Istanbul, Turkey

Conference Topics

01 Modelling and Experimental Assessment of Geomaterials
02 Geohazards, Earthquakes and Risk Mitigation
03 Development of Resilient and Sustainable Geosystems
04 Geotechnical Construction and Soil Improvement
05 Geotechnical Engineering of Multiscale Observations, Sensors and Monitoring
06 Energy Geotechnologies
07 Technological Innovation
08 Geo Education, Standards And Codes

Contact

R. Duzceer
(President of Turkish National Society for ISSMGE)
irduzceer@gelisim.edu.tr

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ & ΑΝΤΙΣΕΙΣΜΙΚΗ ΜΗΧΑΝΙΚΗ

Ακαδημία Αθηνών
Κέντρο Ερεύνης Φυσικών Καταστροφών
Εσπερίδα «ΔΙΑΛΟΓΟΙ ΓΙΑ ΤΗΝ ΣΑΝΤΟΡΙΝΗ»

Το Κέντρο Ερεύνης Φυσικών Καταστροφών της Ακαδημίας Αθηνών διοργάνωσε την 31η Μαρτίου 2025 εσπερίδα με θέμα **"ΔΙΑΛΟΓΟΙ ΓΙΑ ΤΗΝ ΣΑΝΤΟΡΙΝΗ"**.

Η εκδήλωση εστίασε στις πρόσφατες σεισμολογικές, γεωλογικές και γεωδαιτικές παρατηρήσεις, καθώς και στις ηφαιστειοτεκτονικές επιδράσεις στην περιοχή Σαντορίνης-Ανύδρου-Αμοργού.

Ομιλητές ήταν οι

- **Pierre Briole**, Ecole normale supérieure,
- **Emillie Hooft**, University of Oregon
- **Stephanie Prejean**, United States Geological Survey
- **Dave Pyle**, University of Oxford,
- **Margarita Segou**, British Geological Survey,
- **Θανάσης Γκανάς**, Εθνικό Αστεροσκοπείο Αθηνών
- **Έυη Νομικού**, Εθνικό και Καποδιστριακό Πανεπιστήμιο

Την συζήτηση συντόνισε ο Ακαδημαικός **Κώστας Συνολάκης** και την έκλεισε με χαιρετισμό ο Γενικός Γραμματέας της Ακαδημίας Αθηνών, Ακαδημαϊκός **Χρήστος Ζερεφός**.

Η εσπερίδα μεταδόθηκε και ζωντανά μέσω του συυνδέσμου: https://www.academyofathens.gr/el/news/20250331

Μία σύνοψη της εσπερίδας δημοσιεύθηκε στο φύλλο της εφημερίδας Η ΚΑΘΗΜΕΡΙΝΗ της Τρίτης 2 Απριλιου 2025

Αντίθετα «τράβηξαν» Νάξος και Αστυπάλαια

Οι μετακινήσεις των νησιών, οι τέσσερις φάσεις της σεισμικής κρίσης στη Σαντορίνη και τα διδάγματα για τους επιστήμονες

«Το τέλειο φυσικό παράδειγμα για να καταλάβουμε τι συνέβη στη **Σαντορίνη** είναι η μηχανή του εσπρέσσο. Η κάψουλα του καφέ συμβολίζει έναν συγκεκριμένο χώρο, μια περιοχή. Βάζουμε την κάψουλα στη μηχανή. Μετά έρχεται με πίεση το θερμό νερό, κυκλοφορεί στην κάψουλα και δημιουργεί μια υπερ-πίεση. Τη στιγμή αυτή τα ενδεχόμενα είναι δύο: ή η ακίδα της μηχανής θα ανοίξει μια τρύπα στην κάψουλα δημιουργώντας μια έξοδο για το υγρό. Ή η υπερ-πίεση θα συνεχιστεί, με αποτέλεσμα η μηχανή να σπάσει. Αυτή η πίεση, η οποία δεν εκτονώθηκε, είναι αυτή που προκάλεσε τα 5 Ρίχτερ τις πρώτες ημέρες της κρίσης».

Με αυτή την ενδιαφέρουσα παρομοίωση η **Μαργαρίτα Σέγκου**, διευθύντρια Ερευνών στο British Geological Survey, περιέγραψε πολύ συνοπτικά τον μηχανισμό που οδήγησε στην κρίση του περασμένου Φεβρουαρίου. Μια κρίση που, όπως ανέφερε ο διευθυντής Ερευνών στο Γεωδυναμικό Ινστιτούτο **Θανάσης Γκανάς**, είχε ως αποτέλεσμα να μετακινηθούν η **Αστυπάλαια** και η **Νάξος** κατά 2 και 2,8 εκατοστά αντίστοιχα. Και, όπως προσέθεσε η καθηγήτρια Γεωλογικής Ωκεανογραφίας στο Πανεπιστήμιο Αθηνών **Εύη Νομικού**, η περιοχή του υποθαλάσσιου υφαιστείου του Κολούμπο να βυθιστεί κατά 19 εκατοστά.

Οι πολύ ενδιαφέρουσες ανακοινώσεις έγιναν προχθές σε επιστημονική εκδήλωση, που διοργάνωσε το Κέντρο Ερευνας Φυσικών Καταστροφών της Ακαδημίας Αθηνών, με θέμα «Διάλογοι για τη Σαντορίνη», με τη συμμετοχή επιφανών επιστημόνων από την Ελλάδα και το εξωτερικό.

Είναι απαραίτητο να δημιουργηθεί ένα ηφαιστειακό παρατηρητήριο, τόνισε ο διευθυντής Ερευνών στο Γεωδυναμικό Ινστιτούτο Θανάσης Γκανάς σε εκδήλωση με τη συμμετοχή ειδικών από την Ελλάδα και το εξωτερικό.

Η **Μαργαρίτα Σέγκου** περιέγραψε πώς η κρίση της Σαντορίνης ξεδιπλώθηκε σε τέσσερις φάσεις. «Στην πρώτη φάση, έως την 1η Φεβρουαρίου, υπήρχαν σεισμικά γεγονότα, αλλά μειωμένα. Στη δεύτερη φάση, από 2 έως 5 Φεβρουαρίου, παρατηρείται μια έντονη αύξηση της σεισμικότητας, με σεισμούς έως 5 Ρίχτερ. Αιτία είναι η κατάτμηση των πετρωμάτων από την πίεση που ασκεί από κάτω το μάγμα. Στην τρίτη φάση, από 6 έως 10 Φεβρουαρίου, πραγματοποιείται μετακίνηση του μάγματος και αυξημένα σεισμικά επεισόδια. Τέλος, στην τέταρτη φάση, από 11 έως 14 Φεβρουαρίου, αρχίζει και γίνεται περισσότερο αντιληπτή από τους ρυθμούς της σεισμικότητας ότι υπάρχει εμπλοκή και των ρηγμάτων της περιοχής».

Ο κ. Γκανάς από την πλευρά του αναφέρθηκε στις σεισμοτεκτονικές διεργασίες στην ευρύτερη περιοχή. «Κάθε χρόνο η **Σαντορίνη** και η **Αμοργός** μετακινούνται κατά 4,5 χιλιοστά προς τα βορειοανατολικά και η Αστυπάλαια με την Ανάφη προς τα νοτιοδυτικά και ταυτόχρονα μετατοπίζονται και οριζόντια. Χάρη στην κρίση του Φεβρουαρίου, η Αστυπάλαια μετακινήθηκε κατά 2 εκατοστά προς τα νοτιοανατολικά, ενώ η **Νάξος** κατά 2,8 εκατοστά προς τα βόρεια-βορειοδυτικά. Η Ανυδρος, όπως προκύπτει από τα δορυφορικά δεδομένα, μετακινήθηκε κατά 14 εκατοστά προς τα δυτικά και βυθίστηκε κατά 12 εκατοστά, καθώς βρέθηκε στο επίκεντρο της ηφαιστειακής-τεκτονικής δραστηριότητας». Οπως ανέφερε, ο με-

γιστος σεισμός στην περιοχή ήταν 5,3 Ρίχτερ, ωστόσο το δυναμικό των υποθαλάσσιων ρηγμάτων μπορεί να φθάσει στα 7,1 Ρίχτερ (+/- 0,3).

Συνεργασίες και δεδομένα

«Ημασταν τυχεροί γιατί η περιοχή μελετάται πολλά χρόνια. Ετσι γνωρίζαμε τα ρήγματα – υπάρχουν περιπτώσεις που γίνεται ένας υποθαλάσσιος σεισμός και αναρωτιόμαστε πού ακριβώς έγινε. Και επειδή έχουν γίνει πολλές συνεργασίες με ξένα πανεπιστήμια και ωκεανογραφικές αποστολές στη Σαντορίνη, διαθέτουμε πολλά δεδομένα, παρότι εμείς ως χώρα δεν ευνοούμε τη θαλάσσια έρευνα», **εξηγεί στην «Κ» η κ. Νομικού**. «Επιπλέον ήμασταν τυχεροί γιατί στις 24 Δεκεμβρίου, στο πλαίσιο ερευνητικού προγράμματος, τοποθετήσαμε υποθαλάσσιους σεισμογράφους και αισθητήρες μετακίνησης του πυθμένα. Οι συσκευές αυτές μας έδειξαν ότι η περιοχή του Κολούμπο βυθίστηκε κατά 19 εκατοστά, μια καταγραφή που συμφωνεί με τα δεδομένα που προέρχονται από την ξηρά».

Οι επιστήμονες που συμμετείχαν στην εκδήλωση της Ακαδημίας Αθηνών ανέλυσαν το πώς λειτούργησαν οι μαγματικοί θάλαμοι που βρίσκονται στην ευρύτερη περιοχή της Σαντορίνης. «Συνθέτοντας όλα τα δεδομένα καταλήγουμε στο συμπέρασμα ότι οι επαναλαμβανόμενοι σεισμοί είχαν ως αιτία μια "φλέβα τροφοδοσίας", τη μετακίνηση ρευστών από βαθύτερους μαγματικούς θαλάμους προς την επιφάνεια, μια κίνηση που μετακίνησε τα ρήγματα και προκάλεσε τους σεισμούς. Είναι ξεκάθαρο ότι δεν ήταν καθαρά τεκτονικοί οι σεισμοί».

Το εντυπωσιακό στην περίπτωση της **πρόσφατης ηφαιστειακής-σεισμικής κρίσης στη Σαντορίνη** είναι ότι οι επιστήμονες κατέληξαν στα συμπεράσματα αυτά μέσα σε μερικές εβδομάδες, όταν σε αντίστοιχες περιπτώσεις στο παρελθόν χρειάστηκαν μήνες ή και χρόνια. «Πλέον στις επιστημονικές ομάδες οι επιστήμονες συνεργάζονται με αναλυτές δεδομένων», εκτιμά η κ. Σέγκου, από το British Geological Survey. Εμείς επεξεργαστήκαμε τα στοιχεία με βάση έναν αλγόριθμο μηχανικής εκμάθησης, που συστηματικά ανιχνεύει δέκα φορές περισσότερα γεγονότα από ό,τι οι καθιερωμένες τεχνικές. Έτσι την 1η Φεβρουαρίου, λίγο πριν αρχίσει η κρίση, είδαμε ότι η έξαρση είχε αρχίσει από τις 30 Νοεμβρίου. Με τη χρήση των νέων τεχνολογικών εργαλείων ο χρόνος επιστημονικής απόκρισης έχει μειωθεί σημαντικά. Αναγνωρίζοντας ότι η κρίση στη Σαντορίνη είχε ως αιτία μια οριζόντια μαγματική φλέβα και ότι αυτού του είδους τα γεγονότα επανέρχονται και έχοντας δει τι μπορούμε να κάνουμε με τη χρήση τεχνητής νοημοσύνης, οφείλουμε να συντονιστούμε: όλα τα επιστημονικά όργανα να βελτιώσουμε τα δίκτυά μας, ώστε να είμαστε έτοιμοι για την επόμενη φορά».

«Νομίζω ότι η περίπτωση της Σαντορίνης μας έδειξε ότι πρέπει να δημιουργηθεί ένα ηφαιστειακό παρατηρητήριο», εκτιμά ο κ. Γκανάς, από το Γεωδυναμικό Ινστιτούτο. «Επίσης μας αποδεικνύει την ανάγκη να είναι ελεύθερα και ανοιχτά όλα τα επιστημονικά δεδομένα όλων των δικτύων προς όλους». Στην παρουσίασή του ο κ. Γκανάς σημείωσε ότι τα δεδομένα HEPOS του κτηματολογίου είναι διαθέσιμα μόνο μετά από αίτηση και ότι χρειάστηκε παρέμβαση του τότε υφυπουργού Κώστα Κυρανάκη για να δοθούν γρήγορα στο Γεωδυναμικό Ινστιτούτο. «Ας μη μιλάμε όμως μόνο για τις δυσκολίες… Έως τις αρχές Απριλίου στην ευρύτερη περιοχή θα λειτουργούν **32 σταθμοί GNSS καταγραφής μετακινήσεων του εδάφους**, εκ των οποίων οι 21 στη Σαντορίνη. Πρόκειται για κάτι πρωτοφανές για τα ελληνικά δεδομένα».

«Συνεχής παρακολούθηση»

«Είναι υπερ-απαραίτητο να παρακολουθείται το Κολούμπο, με όργανα τοποθετημένα μέσα στον κρατήρα», συμπληρώνει η **Εύη Νομικού**, από το τμήμα Γεωλογίας και Γεωπεριβάλλοντος του Πανεπιστημίου Αθηνών. «Ημασταν τυχεροί γιατί χάρη στην ωκεανογραφική αποστολή μπορέσαμε να συλλέξουμε στοιχεία και δείγματα αερίων και ρευστών. Η μελέτη και παρακολούθηση της περιοχής, όμως, οφείλει να είναι συνεχής και συστηματική».

«Η Σαντορίνη έχει 380.000 χρόνια ηφαιστειακής ιστορίας, με περισσότερες από 200 γνωστές εκρήξεις», **ανέφερε ο Ντέιβιντ Πάιλ**, καθηγητής στο Πανεπιστήμιο της Οξφόρδης. «Τα πετρώματα μπορούν να μας δείξουν τι συνέβη σε μια έκρηξη, δεν μπορούν όμως να μας πουν για τα γεγονότα που τελικά δεν οδήγησαν σε έκρηξη. Τα τελευταία 15 χρόνια έχουμε καλύτερη κατανόηση τόσο των εκρήξεων που έγιναν όσο και όσων δεν έγιναν. Υπάρχουν διαφορές ανάμεσα στα ηφαιστειακά συστήματα της Σαντορίνης και του Κολούμπο και πρέπει να τα έχουμε υπό συνεχή παρακολούθηση».

(Γιώργος Λιάλιος / Η ΚΑΘΗΜΕΡΙΝΗ, 02.04.2025, https://www.kathimerini.gr/visual/infographics/563543548/antitheta-travixan-naxos-kai-astypalaia/)

Ocean soundwaves could help stop tsunamis

A new study from Cardiff University has shown how underwater soundwaves could mitigate the force of tsunamis.

Published in the *Journal of Fluid Mechanics*, the research describes how sound waves and surface gravity waves – which had previously been thought unrelated due to the disparity in their propagation speeds – can interact. Known as triad resonance, the process requires two acoustic waves and a single surface gravity wave.

By aligning the properties of the different waves correctly, the sound waves can be used to alter the dynamics of the ocean waves. As well as being used to reduce the wave power of a tsunami, the technique could also amplify wave power for enhanced clean energy generation.

"Our study describes how these two wave types, which exist in parallel worlds, can nevertheless exchange energy when the right conditions mature," said Dr Usama Kadri, reader in Applied Mathematics at Cardiff University and lead author of the study.

"This 'conversation' between acoustic waves and surface gravity waves is made possible by a unique three-wave interaction known as triad resonance. In theory, this process allows us to effectively control wave energy – either by reducing destructive waves like tsunamis or boosting ocean waves for renewable energy capture.

"This is important because it offers us a physics-based way to reduce tsunami energy, weakening them significantly,

which is not possible with current methods like seawalls or warning centres."

Dr Kadri has previously explored tsunami mitigation, including an investigation of the 2022 Tonga tsunami where he discovered natural acoustic-gravity interactions influence wave behaviour at an oceanic scale. Building on that work, he has now identified the practical tuning parameters that can be used to control those interactions, including wave frequency and amplitude. Water depth was also found to be a key factor, with shallower waters enhancing the ability of the sound waves to diminish wave power.

"Shallow water dramatically boosts energy transfer, aligning with where tsunamis become most destructive," said Dr Kadri.

"This natural 'sweet spot' could simplify practical applications."

The Cardiff team is also hoping their findings can help address current limitations in marine renewables, which lag significantly behind wind and solar. Existing technologies struggle to efficiently capture energy from ocean waves, especially in deep water. Amplifying surface waves could be a solution and the team is looking at a proof-of-concept to support its theory.

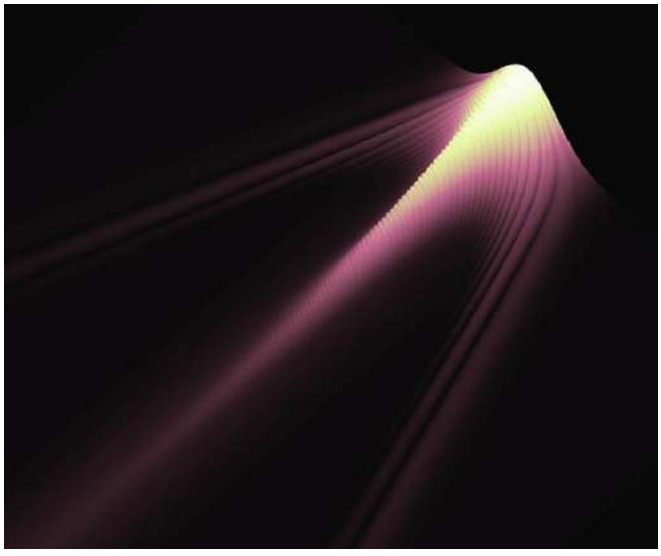
"Once lab validation is achieved, designing real-world scaled acoustic generators becomes an engineering challenge 'only'," said Dr Kadri.

https://www.theengineer.co.uk/content/news/ocean-sound-waves-could-help-stop-tsunamis)

Resonant triad interactions of two acoustic modes and a gravity wave

E. Zuccoli and U. Kadri

Abstract



The interaction between acoustic and surface gravity waves is generally neglected in classical water-wave theory due to their distinct propagation speeds. However, nonlinear dynamics can facilitate energy exchange through resonant triad interactions. This study focuses on the resonant triad interaction involving two acoustic modes and a single gravity wave in water of finite and deep depths. Using the method of multiple scales, amplitude equations are derived to describe the spatio-temporal behaviour of the system. Energy transfer efficiency is shown to depend on water depth, with reduced transfer in deeper water and enhanced interaction in shallower regimes. Numerical simulations identify parameter ranges, including resonant gravity wavenumber, initial acoustic amplitude and wave packet width, where the gravity-wave amplitude is either amplified or reduced. These results provide insights into applications such as tsunami mitigation and energy harnessing.

(Journal of Fluid Mechanics, Volume 1008 , 10 April 2025 , A15 DOI: https://doi.org/10.1017/jfm.2025.111)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Iran's folded rocks: The crumpled mountains at the intersection of Asia and Europe

Iran's folded rocks are a colorful formation that is part of the Greater Caucasus mountains, which formed when the Eurasian tectonic plate collided with the Arabian plate millions of years ago.

Iran's folded rocks are millions of years old, having formed when the Eurasian and Arabian tectonic plates collided. Satellite image from 2023. (Image credit: NASA Earth Observatory)

QUICK FACTS

Name: "Folded rocks" of the Aladaghlar Mountains

Location: Northwest Iran

Coordinates: 37.126276036681965, 47.61930020667193

Why it's incredible: The landscape looks crumpled and folded from above.

Iran's folded rocks are rugged mountain ridges and valleys to the southwest of the Caspian Sea. They are an extension of the Greater Caucasus mountain belt, which also stretches along Russia's border with Georgia and Azerbaijan.

The folded rocks sit at the intersection of Asia and Europe, where major tectonic forces converge. The rocks are formed of countless sedimentary layers, which were upturned and creased into the landscape we see today during the initial collision between the Arabian and Eurasian tectonic plates. The timing of this collision is hotly debated, with estimates ranging from 10 million to 50 million years ago.

"A tectonic collision between Eurasia and Arabia over millions of years compressed these colorful rock layers, bending them into large folds," NASA officials wrote on the social platform X in January 2024.

The Arabian and Eurasian plates are still converging, and recent research indicates a chunk of oceanic crust that separated the two plates before they collided is now being torn apart under Iraq and Iran. The Neotethys oceanic plate appears to be pulling the region down from below, resulting in an unusual accumulation of sediment at the surface.

Iran's folded rocks are colorful, with vibrant terracotta, greenish and blueish bands that are the result of different sedimentary layers deposited over time. These layers were eroded over millions of years after the initial tectonic collision, exposing the underlying rocks' alternating colors and textures.

Iran's folded rocks captured with a satellite in 2025. The green line curving down from the top of the image is the Qezel Ozan River. Towards the top of the image, a line cutting through the folded rocks shows the Zanjan-Tabriz freeway (Freeway 2). (Image credit: Imagery ©2025 Airbus, CNES / Google maps)

Satellite images of the folded rocks reveal the extent to which the landscape was bunched together over the eons. Scientists at NASA's Jet Propulsion Laboratory colored one such image with infrared to show the various rock layers, as well as vegetation and the human-built Zanjan-Tabriz freeway, which cuts through the folded rocks and connects the cities of Tehran and Tabriz.

Another satellite image from NASA's Earth Observatory highlights the intricacy of Earth's surface in this region and shows the Qezel Ozan River, which hugs the southeast corner of the folded rocks and supplies water for agriculture in the area.

(Sascha Pare / LIVESCIENCE, April 18, 2025, https://www.livescience.com/planet-earth/geology/irans-folded-rocks-the-crumpled-mountains-at-the-intersection-of-asia-and-europe)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

Σβάρτσιλντ και Αϊνστάιν

Να μή ξεχνάμε το όνομα του Καρλ Σβάρτσιλντ (Karl Schwartzild, 1873-1916). Ηταν με τις δικές του εξισώσεις που ο Γερμανός αστροφυσικός (σημαντικό όνομα στον καιρό του), στην ουσία **υπέδειξε στον Αϊνστάιν ότι**, με βάση τους νόμους της δικής του θεωρίας, η κατάρρευση ενός άστρου μεγάλης μάζας πρέπει λογικά να οδηγεί σε μια τερατωδία: σε ένα αδιανόητα μικροσκοπικό σημείο άπειρης πυκνότητας, σε κάτι δηλαδή σαν ρωγμή στην υφή του χωροχρόνου, από τις ασύλληπτες βαρυτικές δυνάμεις της οποίας ούτε και αυτό το φως δεν θα μπορούσε να ξεφύγει – με άλλα λόγια, σε **αυτό που σήμερα γνωρίζουμε ως «μαύρη τρύπα»**. Την περίπτωση του Σβάρτσιλντ αφηγείται ο αστροφυσικός Κιπ Θορν (νομπελίστας το 2017 για τον εντοπισμό των βαρυτικών κυμάτων έπειτα από σύγκρουση δύο μαύρων τρυπών) στο δίτομο «Μαύρες τρύπες και στρεβλώσεις του χρόνου. Η προκλητική κληρονομιά του Αϊνστάιν» (εκδ. Κάτοπτρο, 1999).

Ο Σβάρτσιλντ υπηρετούσε στο ρωσικό μέτωπο όταν έπεσε στα χέρια του το τεύχος των Πρακτικών της Πρωσικής Ακαδημίας Επιστημών της 25ης Νοεμβρίου του 1915, όπου και δημοσιευ-όταν η εργασία του Αϊνστάιν για τη Γενική Σχετικότητα. Οπως γράφει ο Θορν, «πολύ σύντομα επιχείρησε να ανακαλύψει τις προβλέψεις των νέων βαρυτικών νόμων του Αϊνστάιν για τα άστρα. (…) Ο υπολογισμός του ήταν κομψός και η γεωμετρία του καμπυλωμένου χωροχρόνου που προέβλεπε, **η "Γεωμετρία Σβάρτσιλντ"**, όπως έγινε σύντομα γνωστή, **έμελλε να επηρεάσει σε μεγάλο βαθμό τις αντιλήψεις μας για τη βαρύτητα και το σύμπαν»**.

Η «Γεωμετρία Σβάρτσιλντ» προέβλεπε ότι για κάθε άστρο υπάρχει μια κρίσιμη περίμετρος, η οποία εξαρτάται από τη μάζα του: αυτό που παραξένεψε τον ίδιο τον Αϊνστάιν αλλά και ολόκληρη τη διεθνή κοινότητα των αστροφυσικών από το 1920 έως και το 1960, ήταν η πρόβλεψη για ένα άστρο με περίμετρο ακριβώς ίση με την κρίσιμη: σε αυτό, ο χώρος στη γειτονιά αυτού του άστρου είναι έντονα καμπυλωμένος και η διαστολή του χρόνου στην επιφάνειά του γίνεται άπειρη, δηλαδή ο χρόνος δεν κυλάει καθόλου, «παγώνει». Κατά συνέπεια, το φως «παγιδεύεται», το μήκος κύματός του γίνεται και αυτό άπειρο, άρα το άστρο πλέον πρέπει να φαίνεται απολύτως σκοτεινό.

Ο Σβάρτσιλντ απέστειλε στον Αϊνστάιν δύο εργασίες του βασισμένες στη δική του θεωρία. Ηταν στη δεύτερη όπου αναπτυσσόταν ο ακριβής υπολογισμός της καμπυλότητας του χωροχρόνου στο εσωτερικό του άστρου και ο Αϊνστάιν τη διάβασε στη Πρωσική Ακαδημία Επιστημών στο Βερολίνο, στις αρχές του 1916. Αλίμονο, την επόμενη φορά που ο Αϊνστάιν θα μιλούσε για τον Σβάρτσιλντ στην Πρωσική Ακαδημία θα ή-ταν για να ανακοινώσει τον θάνατό του στο ρωσικό μέτωπο από μεταδοτική ασθένεια.

Ομως, και πάλι ο Σβάρτσιλντ δεν ήταν ο πρώτος που προέβλεψε κάτι τέτοιο. Ο Βρετανός φυσικός, φιλόσοφος **Τζον Μίτσελ**, το μακρινό 1783, έκανε λόγο για ετοιμοθάνατα άστρα με «κρίσιμη περίμετρο» που θα πρέπει λογικά να απορροφούν το φως και να εμφανίζονται σκοτεινά.

Δεκατρία χρόνια μετά, το 1796, ο Γάλλος φυσικός φιλόσοφος **Πιερ-Σιμόν Λαπλάς** έκανε ευρέως γνωστή την ίδια πρόβλεψη στο περίφημο έργο του «Το σύστημα του κόσμου». Αυτά σε μια εποχή όπου το φως εκλαμβάνεται ως συλλογή από σωματίδια. Ωστόσο, η ανακάλυψη της συμβολής του φωτός ως κύμα, υποχρέωσε τον Λαπλάς να παραλείψει τα περί «σκοτεινών άστρων» από τις κατοπινές εκδόσεις του «Συστήματος του κόσμου».

Στα τέλη της δεκαετίας του 1930 η «Γεωμετρία Σβάρτσιλντ» ήταν πια γνωστή ως «Ανωμαλία Σβάρτσιλντ», ακριβώς επειδή αυτό που συμβαίνει με τις μαύρες τρύπες είναι μια ανωμαλία. Η «Ανωμαλία Σβάρτσιλντ» επανήλθε στο προσκήνιο με μια εργασία του Ρόμπερτ Οπενχάιμερ το 1939, η οποία συζητήθηκε έντονα αλλά οποιαδήποτε περαιτέρω συζήτηση εγκαταλείφθηκε εξαιτίας του πολέμου. Η αστροφυσική έδωσε τη θέση της στην πυρηνική φυσική για πολεμικούς σκοπούς με τα γνωστά αποτελέσματα. Ουσιαστικά, όλοι οι μεγάλοι επιστήμονες της Αμερικής που ασχολήθηκαν με αυτό που αργότερα έγινε γνωστό ως «μαύρες τρύπες», συμμετείχαν στα μεγάλα αμερικανικά ατομικά προγράμματα.

Θα χρειαστεί να φτάσουμε στο 1967, όταν σε μια σχετική διάλεξη του κορυφαίου Αμερικανού φυσικού Τζον Αρτσιμπαλντ Ουίλερ, μπροστά στη δυσφορία του καθηγητή του σχετικά με το πώς πρέπει να ονομαστούν αυτές οι «αστρικές ανωμαλίες», ένας φοιτητής πέταξε: «Γιατί όχι μαύρες τρύπες;» Αυτό ήταν. Επρόκειτο για μια πολύ ελκυστική ονομασία που θα ζήλευε και ένας καλός διαφημιστής.

Πίσω, όμως **στο 1916, όταν ο χαρισματικός Σβάρτσιλντ ουσιαστικά προέβλεψε τη μαθηματική ύπαρξή τους,** ο Αϊνστάιν, παρά τον θαυμασμό του προς τους υπολογισμούς του Σβάρτσιλντ, απέρριψε κάθε ενδεχόμενο πραγματικής ύπαρξής τους, θεωρώντας ότι η φύση θα είχε κάποια ασφαλιστική δικλίδα ώστε να μην επιτρέψει μια τέτοια τερατωδία. **Τώρα πια ξέρουμε ότι εδώ ο Αϊνστάϊν έκανε λάθος** και ότι η φύση είναι πολύ πιο αλλόκοτη και από την πιο τρελή φαντασία.

Μετρική Σβάρτσιλντ

Στην Θεωρία της Σχετικότητας του Άλμπερτ Αϊνστάιν, η **μετρική Σβάρτσιλντ** (γνωστή και ως η λύση Σβάρτσιλντ) είναι μια ακριβής λύση στις πεδιακές εξισώσεις του Αϊνστάιν, η οποία περιγράφει το βαρυτικό πεδίο έξω από μια σφαιρική μάζα, με την υπόθεση ότι η ηλεκτρική φόρτιση της μάζας, η γωνιώδης δυναμική της και η καθολική κοσμολογική σταθερά είναι όλα μηδέν. Αυτή η μετρική είναι μια χρήσιμη προσέγγιση για την περιγραφή των αργά περιστρεφόμενων αστρικών αντικειμένων όπως αστέρες και πλανήτες σαν τον Ήλιο και τη Γη, αντίστοιχα.

Η μετρική καθιερώθηκε από τον Καρλ Σβάρτσιλντ το 1916. Η μετρική Σβάρτσιλντ παίζει σημαντικό ρόλο και σε άλλα θέματα πέραν της θεωρίας της σχετικότητας, όπως η χωροχρονική μοναδικότητα, η πεδιακή κβαντική θεωρία, η βαρυτική κατάρρευση και άλλα.

World's largest wooden structure encircles Expo 2025 Osaka

https://www.youtube.com/watch?v=eECndMY-WV0&t=1s

A gridded wooden structure formed using traditional joinery makes up The Grand Ring, which Japanese studio Sou Fujimoto Architects has used to encircle the Expo 2025 Osaka in Japan.

At 61,035 square metres, it is the largest wooden architectural structure in the world, according to Guinness World Records.

The Grand Ring has opened at Expo 2025 Osaka

The Grand Ring was designed by Sou Fujimoto Architects as Expo 2025 Osaka's main circulation route, but also to provide spaces for visitors to take shelter from rain, wind and sun.

Its circular design, which has a circumference of two kilometres and a diameter of 700 metres, is intended to symbolise unity between the 150 participating countries.

"Expos bring all the wonder of each different country and then stay there for six months," architect Sou Fujimoto told Dezeen.

It is the world's largest wooden architectural structure

"And this format, I thought, is very precious, especially in this crisis of the global situation."

It has a two-kilometre circumference

The Expo 2025 Osaka takes place on the artificial island of Yumeshima in Osaka Bay.

It was masterplanned by Sou Fujimoto Architects in collaboration with fellow Japanese studios Tohata Architects & Engineers and Azusa Sekkei.

The Grand Ring has a modular, dismantlable wooden structure that marries modern and traditional construction techniques, such as Nuki joints – a Japanese connection in which a horizontal beam is slotted through a vertical post, often seen in traditional temples and shrines.

Approximately 70 per cent of the timber used for the structure was sourced in Japan, including cedar and cypress, while the remaining 30 per cent is foreign Scots pine.

It was constructed partly using traditional Japanese joinery techniques

The circulation route, named The Ring Skywalk, is elevated 12 metres on top of the structure and accessed by escalators and lifts.

There is a lower and upper level, providing views out over Osaka and Osaka Bay, and back into the Expo site.

As with the majority of structures at the Expo 2025 Osaka, The Grand Ring was designed to be dismantled.

However, a final decision is yet to be made about whether or not it will be taken down and repurposed or preserved in part or in full.

Among the national pavilions contained within The Grand Ring are the boat-like Bahrain Pavilion by Lina Ghotmeh and the theatrical France Pavilion by Coldefy and Carlo Ratti Associati.

These featured in our roundup of 10 stand-out pavilions at Expo 2025 Osaka, which also included The Ocean Dome by Shigeru Ban, which sits just outside of The Grand Ring.

The video is by Expo 2025 Osaka and the photography is by Lizzie Crook.

Expo 2025 Osaka takes place in Osaka until 13 October 2025. For more fairs, events and talks in architecture and design visit Dezeen Events Guide.

It acts as the site's main circulation route

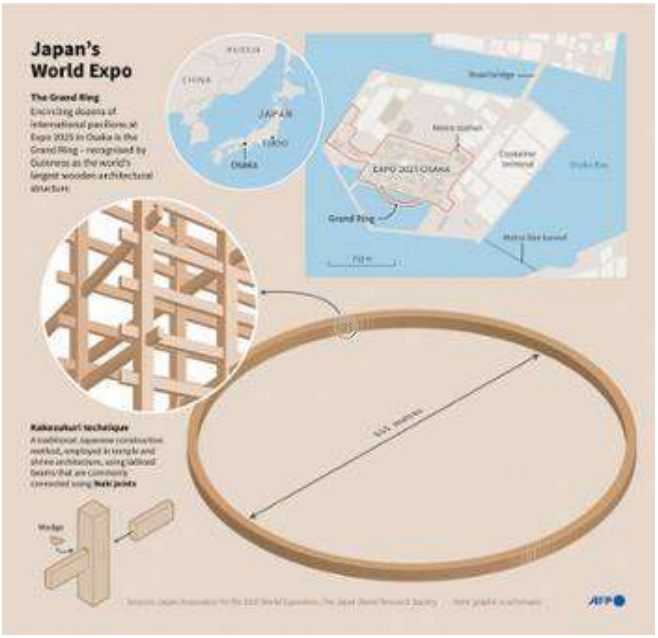
It provides views over the Expo as well as Osaka Bay

(Lizzie Crook / dezeen, 24 April 2025, https://www.dezeen.com/2025/04/24/the-grand-ring-expo-2025-osaka)

Grand Ring unveiled in Japan

The Grand Ring, the world's largest wooden structure, has been unveiled at Expo 2025 in Osaka, Japan. Designed by

Sou Fujimoto Architects, the structure is a 1.2-mile circular loop made primarily of local cypress and cedar using traditional Nuki joints. It features a Sky Walk at 40 feet, offering views of the expo.



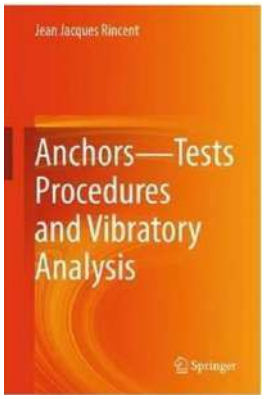
SmartTake: Cross-laminated timber and, to a lesser extent, glulam are used in the Ring. Just another sign that the mass timber movement isn't slowing down. Nowhere is this more apparent than in tree-covered Canada, where successful pilots and decreasing costs are driving adopton. The cost premium for mass timber has dropped to single digits.

People visit the Grand Roof (Ring), the symbol of the venue, during the opening day of the World Expo 2025 Osaka at Yumeshima on April 13, 2025 in Osaka, Japan. (Vcg/Getty Images)

Full Story: Dezeen (4/27), New Atlas (4/25)

(Smart**Brief** *for* Civil Engineers, April 29, 2025, https://newsletter.smartbrief.com/servlet/encodeServlet?issueid=3C0F6DBB-1E04-4110-9A79-3877F8D3D70F&sid=E1268C6B-95C4-4A2E-9B45-A0C005517D88)

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



Anchors—Tests Procedures and Vibratory Analysis

Jean Jacques Rincent

Overview

Is a summary of experience gained from the analysis over 24 000 test curves obtained from 3000 ground anchors analysis

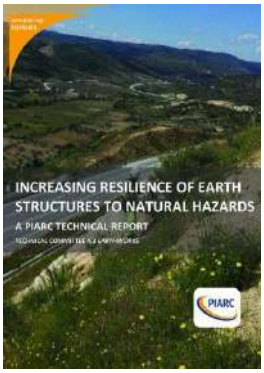
Provides practical feedback on the complexity of non-destructive testing

Aims to increase the durability of the retaining structures

About this book

This book follows: Ground Anchors: Tension Force Vibratory Analysis JJ Rincent Springer Sept 2024. This new book is a summary of experience gained from the analysis of over 24 000 test curves obtained from 3000 ground anchors analysis. It provides practical feedback on the complexity of non-destructive testing. The test equipment, the rules to obtain interpretable acquisition results. The examples come from trials carried out in Brazil over the last 5 years and finally, the test methodology adopted for this experiment. These tests are generally carried out on ground anchors using strands as reinforcement or rebars several decades old. Information on their length and initial tension force is often non-existent after 40 years. That's why these vibration analysis tests provide the answers and information needed for stability and maintenance diagnostics. The examples chosen concern ground anchors equipped with bars, strands and also for nails, passive ground anchors and micro piles. Tests on prestressed dowels are described, and a test on a reinforcing bar linked to the construction of an early 16th century castle will be carried out. As a reminder that these tests results lead to define the total length of the tie bar, the free length, the diameter of the tie bar, i.e. the reinforcement with its cement grout, and finally the tension force at the time of testing. These data are essential for assessing the stability of retaining walls stabilised by tie rods. It should be stated that static tests, which are difficult to carry out at height, provide no information on lengths and run the risk of breaking old tie rods. All the tests carried out are used to construct the test method that can be adopted, taking into account the feedback acquired from thousands of static tests. For retaining structures and tie rods in particular, access to the head of the tie rods must be preserved in order to: - carry out inspection tests - re-tension the tie rods, if necessary - while protecting them from corrosion. Meeting these conditions means implementing sustainable maintenance of the structures. This test method is a diagnostic tool for ground anchors used by managers of retaining structures to design maintenance projects. The final aim is to increase the durability of the retaining structures. The tests proposed and explained using numerous examples and finally to propose a methodology for carrying out vibration analysis tests on ground anchors, as well as a framework for their interpretation.

(Springer, 2025, https://link.springer.com/book/10.1007/978-981-96-3777-5)



Increasing Resilience of Earth Structures to Natural Hazards

A PRIARC Technical Report

Technical Committee 4.3
EARTHWORKS

This report provides a complete background on the topic of "Increasing Resilience of Earth Structures to Natural Hazards" assigned to WG1 of PIARC TC 4.3 as part of the 2020-2023 Work Program. This topic has been developed as part of the 2020-2023 Work Cycle and is complemented by two additional documents for this topic: a Case Studies Report and a Literature Review Report.

The production of this report was carried out in multiple phases. The first phase involved a cursory review and selection of relevant documents from the literature that address, directly or indirectly, the concept of resilience. The selected documents address the concept of resilience in various ways, from the most general meaning of the concept to its specific application in road infrastructure.

In a second phase, relevant case studies related to resilience in earth structures, collected among members of PIARC TC 4.3, have been analyzed using a common framework, to identify which are the most common hazards that are currently affecting earth structures, what is the most common damage they suffer due to these impacts and which are the most common measures that are applied to repair or to adapt these assets.

As a result of this WG1 final review, it was concluded that resilience is a concept that can be applied to earth structures taking into account the whole life cycle of the assets, starting from the inception (design phase) up to construction and management. Specific directions and recommendations have been identified and their application was discussed together with relevant examples taken from cases.

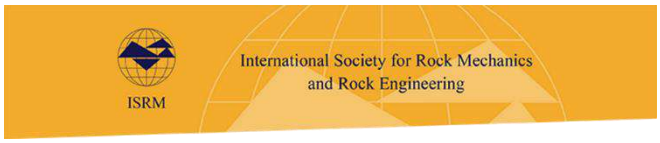
In order to serve its function as background and reference for the resilience concept as applied to earth structures, recommendations and conclusions have been provided in Chapters 10 and 11 of the document.

(2023R54EN - PIARC Technical Report, 2025)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

https://issmge-e.eu/newsletter-april-2025

- **From the Vice President**: Empowering Geotechnical Exchange in a Digital World
- **ISSMGE Europe Announcements**
  - ISSMGE Europe Goes Digital
  - Announcing the 6th European ISSMGE National Assembly, Rome 16, 2025
  - ISSMGE Heritage Time Capsule
- **ISSMGE Europe News**
  - SWISS GEOTECHNICAL SOCIETY: Celebrating 70 Years of the Swiss Geotechnical Society
  - ASSOCIAZIONE GEOTECNICA ITALIANA
  - GERMAN GEOTECHNICAL SOCIETY
  - DANISH GEOTECHNICAL SOCIETY
  - POLISH GEOTECHNICAL SOCIETY: Poland: Advancing Geotechnics Through National and International Exchange
  - SWEDISH GEOTECHNICAL SOCIETY: The Swedish Geotechnical Society celebrates its 75th anniversary.
- **Upcoming Conferences**
  - Spring Conference 2025 – Geotechnical Engineering Switzerland
  - Prague Geotechnical Days 2025
  - The 5th Fachsektionstage Geotechnik – Interdisciplinary Forum
  - EYGEC 2025: Rijeka, Croatia
  - CNG Venezia 2025
  - 10th Geotechnical Symposium - Kocaeli 2025
  - ISSMGE Heritage Time Capsule: Future Focus - Africa & Europe Session
  - ICSMGE 2026: A Centennial Celebration in Vienna
  - Energy geostructures: analysis and design course. Find out more **here**
- **ISSMGE Europe Requests**



ISRM Newsletter No. 69 - Spring 2025

Κυκλοφόρησε επίσης το ISRM Newsletter No. 69 - Spring 2025 με τα ακόλουθα περιεχόμενα:

- EUROCK 2025: Final Countdown to the Conference!
- Richard Goodman 1935-2025
- Volume 26 - 2023 of the ISRM News Journal is online
- Presidential election for the 2027-2031 term of office - two candidates nominated
- ISRM Young Members' Seminar on the ISRM Young Members YouTube channel
- ISRM Workshop on Soft Rocks (ISRM-WSR2025) - bulletin No. 2
- Session on intergenerational dialogue in geotechnics at the 74th Geomechanics Colloquium
- ISRM Rocha Medal 2027 - nominations to be received by 31 December 2025
- ISRM Sponsored Conferences

INTERNATIONAL GEOSYNTHETICS SOCIETY

IGS NEWSLETTER - April 2025

- **IGS Launches 'JP Giroud Legacy' Resource** READ MORE; LEGACY PAGE
- **Second Richard Bathurst Lecturer Revealed** READ MORE
- **Apply Now For GeoAsia8 Travel Grant** ELIGIBILITY RULES; READ MORE
- **IGS Panama Shares Revitalization Plans** READ MORE
- **Northern Brazil's Geosynthetics Needs Explored At Geossint North** READ MORE
- **Corporate Members Invited to Showcase Projects at GeoAsia8** READ MORE
- **North America Launches First 'IGS Student Club'** READ MORE
- **IGS Premium Corporate Membership** READ MORE
- **IGS Foundation Praised On 5th Anniversary** READ MORE
- **GeoAsia8 Keynote Lectures Revealed** READ MORE
- **Upcoming Events**
  - **IGS Nordic EtE (Hybrid) – 7 May 2025** REGISTER
  - **IGS Portugal Webinar - 29 April 2025** REGISTER
  - **IGS North America Webinar - 6 May 2025**. REGISTER
  - **GeoAsia 8 - 10-13 June 2025**, in Brisbane, Australia. www.geoasia8.org
  - **EuroGeo 8 - 15-18 Sept 2025**, in Lille, France. www.eurogeo8.org
  - **13th International Conference on Geosynthetics**
- **Calendar of Events**

Geosynthetics International
www.icevirtuallibrary.com/toc/jgein/32/2

Κυκλοφόρησε το τεύχος Volume 32, Issue 2, April, 2025 του Geosynthetics International της International Geosynthetics Society με τα ακόλουθα περιεχόμενα:

Research Articles

A comparison between geomembrane-sand tests and machine learning predictions, A. T. Tanga; G. L. S. Araújo; F. Evangelista Junior

Mechanical characteristics of geogrids produced from recycled polyester, G. T. Mehrjardi; R. Fuentes; O. Detert

Rubber-sand infilled soilbags as seismic isolation cushions: experimental validation, J. Wang; M. Wu; F. Liu; J. Bin; J. He

Factors affecting the tensile strength of bituminous geomembrane seams, W. Francey; R. K. Rowe

Shear modulus of sand-rubber mixtures: element testing and constitutive modeling, A. Kavand; S. Sarajpoor; A. Ghalandarzadeh; S. Akhyani; P. Zogh

NaCMC-amended clay: effect of mixing method on hydraulic conductivity and polymer elution, S. Taheri; A. El-Zein; B. Yu

Centrifuge modeling of levees with geocomposite chimney drain subjected to flooding, B. V. S. Viswanadham; P. Kumar; R. K. Saran

Investigation of the mechanical response of recovered geogrids under repeated loading, A. Ibrahim; R. L. E. Desbrousses; J. Xu; M. A. Meguid

Permeability of needle-punched nonwoven geotextiles subjected to uniaxial tensile strains, K. Y. Li; X. W. Tang; M. L. Fei; J. Chou; X. L. Chen; Q. Q. Xiang; T. Q. Wang

Geotextile-encased cinder gravel columns: a coupled DEM–FDM analysis, K. Liu; R. Qiu; P. Zhou; T. Wang; D. P. Connolly; J. Xiao

Geotextiles and Geomembranes
www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/53/issue/2

Κυκλοφόρησε το τεύχος Volume 53, Issue 2, April, 2025 του Geotextiles and Geomembranes της International Geosynthetics Society με τα ακόλουθα περιεχόμενα:

Editorial Board, Page ii

Short communication

An approximate solution of consolidation for double-layered ground with different smear radii by vertical drains, Desheng Li, Yonghui Chen, Long Chen, Kaizhe Shang, Junquan Dong, Pages 661-669

Regular Articles

The influence of geosynthetic properties on their shear behaviors at the interface with frozen soil, Pengfei He, Guangliang Hou, Haitao Cao, Feng Yue, Pages 497-509

A novel two-layer composite geomembrane lining structure to mitigate frost damage in cold-region canals: Model test and numerical simulation, Haoyuan Jiang, Mingyi Zhang, Zhengzhong Wang, Yi Wang, ... Xinjian Sun, Pages 510-527

Field test of geosynthetic-reinforced floating pile-supported embankments on soft soil, Rui Rui, Shi-kai He, Long-fan Peng, S.J.M. Van Eekelen, ... Yu-qiu Ye, Pages 528-544

Influence of geogrid reinforcement on the cracking characteristics of expansive soils: A laboratory study, Rui Zhang, Yu Zhou, Yipeng Guo, JianLong Zheng, ... Tian Lan, Pages 545-558

Probabilistic analyses of geosynthetic-reinforced pile-supported embankments using design methods and 3D finite element models considering soil variability, Ekansh Agarwal, Ning Luo, Kaiwen Liu, Pages 559-576

Interface shear creep behavior between the nonwoven geotextile and the geomembrane pre/post peak strength, Jianyong Shi, Yuchen Zhang, Gaojie Xu, Wei Dai, Zhanlei Liu, Pages 577-587

Study on the hydraulic properties of internally unstable soil-nonwoven geotextile systems: Boundary values and preliminary estimates, Ennio M. Palmeira, Matheus V. Souza, Dellane S.C. Santos, Ivonne A.M.G. Góngora, Pages 588-606

Characteristic pore size of nonwoven geotextiles based on low-field nuclear magnetic resonance technology, Xianlei Zhang, Pengpeng Yang, Shaoshuai Ma, Yunyun Wu, Pages 607-618

A model for predicting permeability of geotextile envelope for subsurface drainage after combined clogging in arid areas, Shuai Qin, Chenyao Guo, Jingwei Wu, Shuai He, ... Hang Li, Pages 619-629

Field behavior of a GRS bridge approach retaining wall on highly compressible foundation soils, Chunhai Wang, Huabei Liu, Mengyuan Luo, Kui Gao, ... Kaifeng Zeng, Pages 630-641

Long-term performance of polyethylene geomembranes to contain brine, M. Zafari, R. Kerry Rowe, R. Awad, Pages 642-660

Influence of perforation characteristics and geotextile envelopes on the drain pipe, Yingao Zhang, Shaoli Wang, Ruixia Hao, Pages 670-679

Erratum

Corrigendum to "A large-size model test study on the consolidation effect of construction waste slurry under self-weight and bottom vacuum preloading" [Geotext. Geomembranes, 53, (1), February 2025, (318–330)], Wenhao Jiang, Liangtong Zhan, Junyao Lu, Page 680

https://s3.amazonaws.com/xcdshared/dfi/deep-foundations-magazine/mar-apr-25.pdf

Κυκλοφόρησε το τεύχος Μαρτίου / Απριλίου 2025 του περιοδικού Deep Foundations με τα ακόλουθα περιεχόμενα:

- Cover Story: Digging Deep in Washington, D.C.
- Paw Paw Slope Stabilization
- Overcoming Geological Challenges
- Foundation Reuse by Increasing the Bearing Capacity of Foundation Soil
- A Look Back: Frequency-variable Vibrators and their Application to Foundation Engineering
- Member Profile: For Engineer Chris Nelsen Sustainability is Foundational
- Foundations for a Sustainable Future: Research Advances for Bio-inspired Ground Improvement Alternative
- Risk Corner: The Hidden Cost: The Risk of Ignoring Mental Health in the Heavy Highway Construction Industry

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2023 – 2026)

Πρόεδρος	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Α' Αντιπρόεδρος	:	Σταυρούλα ΚΟΝΤΟΕ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Τμήμα Πολιτικών Μηχανικών Πανεπιστήμιο Πατρών skontoe@upatras.gr
Β' Αντιπρόεδρος	:	Νίκος ΚΛΗΜΗΣ, Δρ. Πολιτικός Μηχανικός, Καθηγητής Τμήμα Πολιτικών Μηχανικών, Πολυτεχνική Σχολή, Δημοκρίτειο Πανεπιστήμιο Θράκης nklimis@civil.duth.gr, nsklimis@gmail.com
Γενικός Γραμματέας	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής Τμήμα Πολιτικών Μηχανικών Σχολή Μηχανικών Πανεπιστημίου Δυτικής Αττικής gbelokas@uniwa.gr, gbelokas@gmail.com
Ταμίας	:	Γιάννης ΖΕΥΓΩΛΗΣ, Δρ. Μηχανικός Μεταλλείων - Μεταλλουργός, Αναπληρωτής Καθηγητής Σχολή Μεταλλειολόγων - Μεταλλουργών Μηχανικών ΕΜΠ izevgolis@metal.ntua.gr
Έφορος	:	Τάσος ΑΝΑΣΤΑΣΙΑΔΗΣ, Δρ. Πολιτικός Μηχανικός, Καθηγητής Τμήμα Πολιτικών Μηχανικών Αριστο-Τελείου Πανεπιστημίου Θεσσαλονίκης anas@civil.auth.gr
Μέλη	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Σχολή Πολιτικών Μηχανικών Ε.Μ.Π. mpanta@central.ntua.gr Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr
Αναπληρωματικά Μέλη	:	Δημήτρης ΠΙΤΙΛΑΚΗΣ, Δρ. Πολιτικός Μηχανικός, Αναπληρωτής Καθηγητής Τμήμα Πολιτικών Μηχανικών Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης dpitilakis@civil.auth.gr Χρήστος ΣΤΡΑΤΑΚΟΣ, Πολιτικός Μηχανικός, NAMALAB Α.Ε. stratakos@namalab.gr Χάρης ΛΑΜΑΡΗΣ, Πολιτικός Μηχανικός, ΧΑΡΗΣ Π. ΛΑΜΑΡΗΣ ΚΑΙ ΣΥΝΕΡΓΑΤΕΣ ΙΚΕ h.lamaris@lamaris.gr Πρόδρομος ΨΑΡΡΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός prod@central.ntua.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