ΕΛΛΗΝΙΚΗ
ΕΠΙΣΤΗΜΟΝΙΚΗ
ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

173

Αρ. 173 – ΜΑΡΤΙΟΣ 2023

The Rainbow Valley In Peru
(https://imgflip.com/i/6ej8ja)

ISSN: 2732-7248

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

ΑΡΘΡΑ

Time history analysis of 15 story building foundation excited with M7.8 Feb. 2023 Syria-Turkey Earthquake

Dr. Nikolaos Lesgidis

In the 6th of February of 2023 an earthquake of 7.8 magnitude occurred in the region of the southeast Turkey followed by a 2nd main sock of 7.5 magnitude 9 hours later. The earthquake had a devasting effect on numerous cities in the region, killing over 17 000 people. Most of the earthquake induced collapses were associated with inefficient or no implementation of seismic design standards in the building construction (i.e. slabs directly supported on beams, lack of shear walls, thin columns with questionable longitudinal reinforcement, non-existing column confinement with limited/ no shear reinforcement in columns). However even if damage was mainly associated with the superstructure of the buildings, the unusually high intensity of the earthquake, surpassing a peak ground acceleration of 1g in multiple recording stations, is of a particular interest for Soil structure interaction. In the current case study, a 15 story archetype building structure is excited with the 1st 7.8 magnitude mainshock excitation and the pilegroup foundation time domain behavior is assessed with the DeepFND software.

A. EARTHQUAKE EXCITATION

The 1st mainsock was captured by multiple stations located within the proximity of the earthquake epicenter. The North East and vertical component of the surface acceleration recorded in station 3125 is selected as the excitation of the current study. The acceleration time series are illustrated in figure 1.

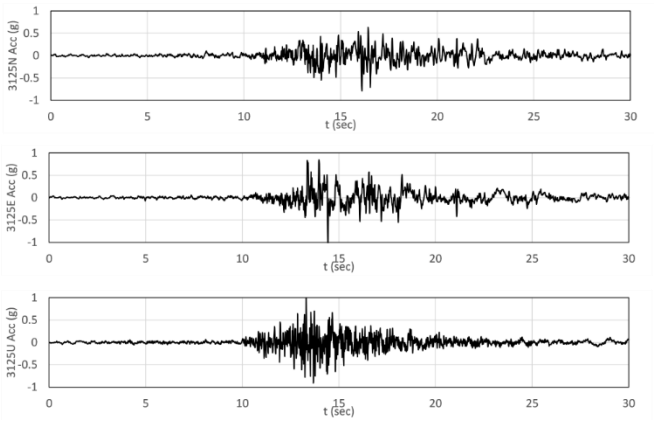


Figure 1: Earthquake acceleration at surface as recorded in station 3125

B. SUPERSTRUCTURE MODEL

For the superstructure a steel frame archetype building with 15 stories is selected, previously assessed under the excitation of multiple high intensity earthquakes in [1]. A simplified single degree of freedom model is considered for the superstructure with an effective mass MSDOF=2116.8 ton, and lateral stiffness KSDOF=51759.38KN/m, matching the documented 1st natural frequency f=0.67Hz.

Flexibility of the pilegroup foundation is also introduced in the superstructure model by assigning a nonlinear spring system at the base of the SDOF version of the building structure. The pilegroup foundation model is constructed in DeepFND (fig. 3) and the force to displacement and moment to rotation relationship is extracted through a pushover analysis as illustrated in Figure 4. Non linear behavior of the structural components of the pilegroup foundation is also introduced in the form of the slice section method taking into consideration various mechanics of damage namely a) spalling of unconfined concrete, b) hoop rupture, c) longitudinal reinforcement yielding and d) confined concrete crushing.

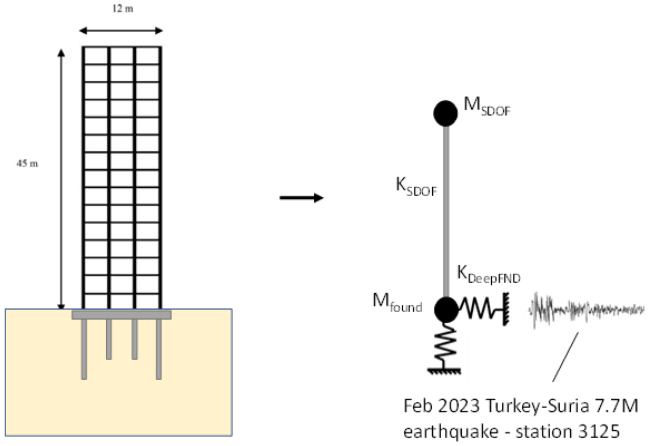


Figure 2: Single Degree of Freedom Superstructure model with SSI

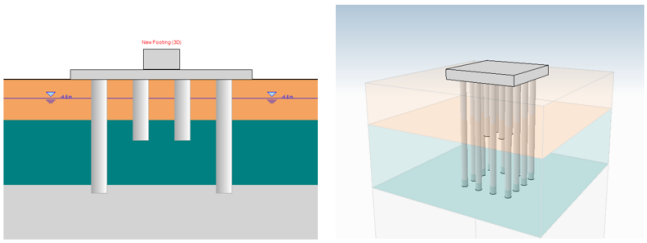


Figure 3: Foundation model constructed in DeepFND

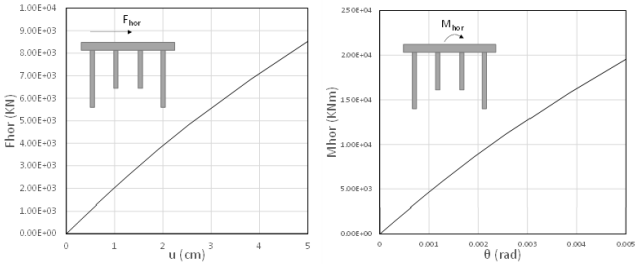


Figure 4: Pushover analysis with DeepFND

The resulting moment and horizontal forces transferred from the superstructure to the foundation system are illustrated in figure 5.

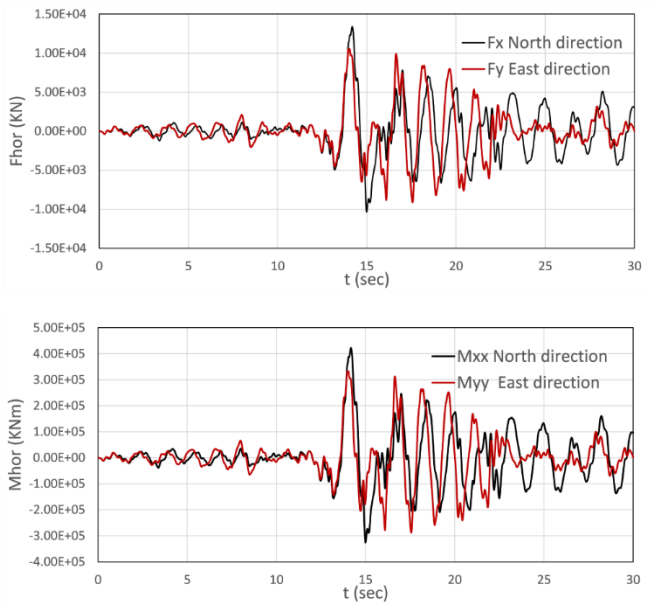


Figure 5: a) horizontal forces and b) moments transferred from the superstructure to the foundation

C. ANALYSIS RESULTS

The analysis results for the foundation are illustrated in the following figures. The deformed shape and contour of displacement of the FEM model is depicted in figure 4 and a comparison of the simulated settlement contour and measured settlement contour are depicted in figure 5.

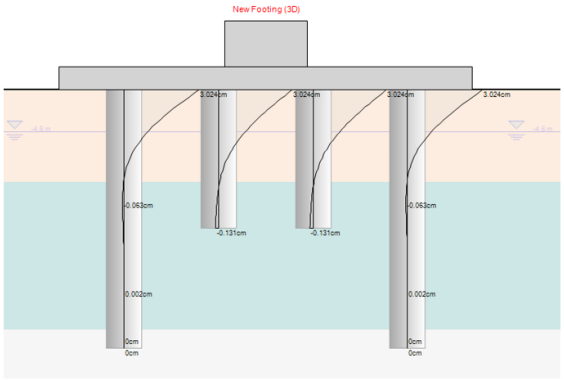


Figure 6: Foundation internal row lateral displacement

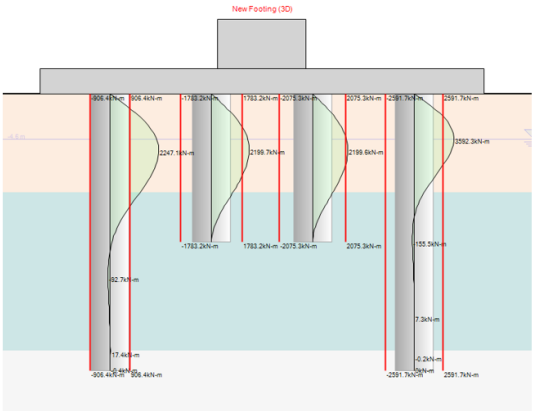


Figure 7: Foundation internal row Moments

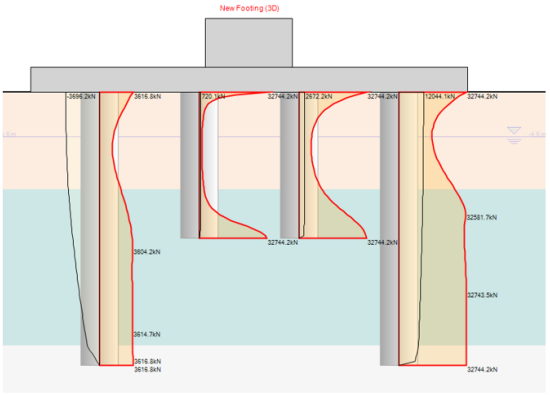


Figure 8: Foundation internal row Axial forces and Axial Wall Capacity

The maximum lateral and vertical displacements of the pile-group are respectively in the order of 3cm and 5 cm. The moment demand of the external piles is expected to be higher than the factored structural moment capacity calculated by the software as illustrated in figure 7. However, with the exception of cover spalling and controlled cracking, no significant damage or formation of plastic hinges in the piles was forecasted by the numerical model.

D. CONCLUSIONS

The Finite element analysis method implemented in DeepFND is utilized to model the seismic response of a pile supported 15-storey building subjected to the recent 7.8M earthquake in Turkey. The pile foundation experiences significant tension forces, and bending moments in the external piles are close to their ultimate structural strength. Vertical displacements are up to 5 cm, and lateral in the order of 3 cm. Based on this response, it appears that while the structure would experience some damage it would survive the earthquake whereas a structure solely on a mat foundation would likely encounter stability issues.

E. REFERENCES

[1] Effect of Seismic Soil–Pile–Structure Interaction on Mid- and High-Rise Steel Buildings Resting on a Group of Pile Foundations, Mohsen Bagheri, S.M.ASCE; Mehdi Ebadi Jamkhaneh, S.M.ASCE; and Bijan Samali, Ph.D.

https://www.deepexcavation.com/en/resources/case-studies/time-history-analysis-building-foundation-in-turkey

Harry Nice Bridge:
A Geotechnical Instrumentation Case Study

Located about an hour drive south from Washington, D.C., the Maryland Transportation Authority (MDTA) contracted with Skanska-Corman-McLean (SCM) to deliver a new Governor Harry W. Nice Memorial/Senator Thomas "Mac" Middleton Bridge, which takes U.S. 301 over the Potomac River, spanning 1.9 mi (3 km) from Maryland to Virginia. The new bridge aimed to improve capacity, safety and access of the roadway and was planned as a four-lane span with deep foundations that would be constructed fewer than 150 ft (45 m) north of the existing alignment of the more than 80-year-old bridge. The new Harry Nice Bridge opened in the fall of 2022 with a design life of more than 100 years, servicing 12 ft (4 m) wide lanes with 2 ft (0.6m) shoulders, doubling capacity, enhancing emergency response, upgrading maintenance and inspection activity access, and featuring lane sharing for cyclists.

The old and new Harry Nice Bridge

Geotechnical Background

The site geotechnical investigation by Schnabel revealed several construction risk factors that could cause in-situ soil movements along the alignment of the bridge. Beneath the top layer of uncontrolled fill depths up to 34 ft (10 m), the Mid-Atlantic Coastal Plain geology of the project site consists of recent terrace and alluvial soil deposits overlying older lower tertiary soils of the Nanjemoy, Marlboro and Aquia formations. The terrace and alluvial soils ranged from depths of up to 46 ft (14 m) at the shores to depths of up to 140 ft (43 m) below the mudline in the deepest sections of the Potomac, and are composed of soft to very soft clays with layers of sand and gravel. The lower tertiary soils encountered below the terrace and alluvial deposits consist of stiff to very stiff or medium dense to very dense clay and sand layering, some of which is cemented.

Risk analysis of site soils determined that with pile driving operations of 36 in (915 mm) square prestressed concrete piles occurring as little as 35 ft (11 m) away from the existing bridge, and embankment fills of up to 30 ft (10 m) directly adjacent to the existing bridge, the impact of lateral displacement, vertical heave, soil densification and vibrations on existing substructure units would fall below structural impact design tolerances. However, to ensure protection of the existing bridge structures and verify the structural impact of adjacent construction, geotechnical instrumentation was recommended to monitor pile driving and embankment fill activity.

Geotechnical Instrumentation Plan

As the geotechnical instrumentation specialist, Foundation Test Group's (FTG) role on the project was to provide engineering services to monitor conditions of the existing bridge utilizing the known geotechnical parameters. In the interest of public safety across the length of the bridge and each embankment approach, the specialist developed an instrumentation monitoring plan that evaluated the movement of soils and existing bridge structures including the abutments, bents, piers, roadway deck, walls and trusses. To understand the impact of adjacent heavy construction on the new bridge and determine preconstruction baseline movements of the existing bridge, a combination of more than 140 instruments of varying types were installed to monitor structural performance.

Existing bridge (left), new bridge pile driving activity (right)

Automated total stations were installed at three locations to monitor 122 prisms across the bridge structure at various elevations on the deck, piers and abutments. For stress level monitoring of steel trusses, eight strain gauges were installed every 500 ft (150 m) along the main navigation span. For rotational monitoring of piers and abutments, 20 tilt sensors were installed at both pier cap and bridge deck elevations. For vibration monitoring of adjacent pile driving, 10 triaxial vibration sensors were installed and rotated as construction progressed. For monitoring of existing deficiencies, 2 automated crack meters were installed on concrete piers. For embankment monitoring, 7 inclinometers, 14 vibrating wire piezometers and 16 settlement plates were installed between each shore approach.

Installation of strain gauges at the existing bridge

The line-of-sight conditions for the structural monitoring points were heavily restricted by several site factors, including property limits, proximity of adjacent construction, haze

disturbance over the brackish water and inability to practically install dedicated reference structures in the waterway. To avoid the progression of new construction inhibiting prism sight lines, the robotic total stations were installed between the new and old bridge alignments, creating difficult line-of-sight angles. Along the length of the 1.9 mi (3 km) construction limits, project budgets allowed for three total station setups: one installed at each of the Maryland and Virginia shorelines and one installed near midway on the existing bridge fender structure at the navigation span on Pier 14.

The available monitoring locations also limited the amount and locations of reference prisms able to be installed on site. With a lack of backsight prism referential control, validity and consistency in engineering analysis of the data had to be created in other ways. One way to re-establish data redundancy and understand the bridge behavior was to overlap the quantity and type of instrument in a single critical location to provide multiple methods of structure evaluation.

At one of the deepest bridge locations, navigation span Pier 14 was equipped with:

- Two tilt sensors – one at the bridge deck elevation and one at the pier water level elevation.
- Three structural monitoring prisms – one at the bridge deck elevation and two at the pier water level elevation, each facing a different total station.
- One strain gauge on an existing steel truss member.
- One vibration sensor measuring vibrations on the existing pier cap.

Instrument redundancy shown at Maryland Abutment during preconstruction phase (up), and during superstructure construction phase (down)

Continuous monitoring of the data trends was performed, sometimes through evenings and weekends during critical construction stages, to evaluate triggered alerts for validity and consideration of the types of causes. With supply chain shortages starting to develop in the summer of 2020 and contractor schedule ramping up, the baseline monitoring phase quickly transitioned into the construction monitoring phase with little opportunity to increase the instrument coverage. Having a strong geotechnical analysis of the instruments in place during the beginning stages of construction was integral to project success.

Throughout the project the instrument data was routinely analyzed for performance and adjustments were made to tighten or loosen design alert threshold levels accordingly. Temperature-induced effects were observed on both a daily and seasonal cycle, with greatest impacts during the winter period as the freezing point was routinely crossed. Another constant factor in data analysis that required early design changes was the effect of dynamic traffic loads on the existing bridge deck designed for anticipated flexural movement. Tilt sensors installed on the bridge deck parapet wall typically experienced tilt fluctuation magnitudes of +/-0.3 degrees greater than accompanying tilt sensors installed at the water level elevation on existing pier caps.

Results of Instrumentation and Monitoring

Beginning in May 2020, vibration sensors were installed on the existing bridge from the Maryland abutment to the Virginia abutment for structure vibration monitoring. Vibration sensors were regularly relocated to various bents and piers to coincide with adjacent pile driving operations as they advanced. An evaluation of each vibration sensor dataset over at least a 20-month-long monitoring period, in conjunction with data observed from tilt sensors and prisms at same locations, showed no long-term structural effects on the existing bridge due to construction-induced vibrations. Over the course of the project, pile driving activity at several locations produced elevated vibration levels in existing structures above baseline levels. However, vibration readings were never observed above the design alert threshold level of 0.5 in/s (13 mm/s) established by the owner's specifications.

The precast concrete piles were designed to develop their side resistance in stiff Nanjemoy and Marlboro soils as well as dense to very dense Aquia sands. New pile driving impacts that were expected to occur at the adjacent bridge substructure units, which consisted of a combination of steel, concrete and timber piling support, had calculated ranges up to 0.7 in (18 mm) of lateral ground displacement and 1.1 in/s (28 mm/s) of anticipated peak particle velocity.

On July 6, 2021, increased lateral ground movement of up to 2 in (50mm) was observed at VA-INC-4, at a depth of 55 ft (18 m) below grade, during and after pile driving activity at the adjacent Virginia Abutment A.

The 36 in (915 mm) square prestressed concrete pile had a required driving design resistance of 954 kip (4,250 kN), minimum plan depth of 93 ft (28 m), with blows per foot ranging from four to seven at the depths where soil displacement was greatest. Re-evaluation of the original geotechnical report analysis determined that the soil displacements were caused by a combination of shoving and heaving between various soil strata with varying consistencies as the nearby pile was driven.

Due to the magnitude of the lateral soil movement profile, data from the inclinometer and other nearby instrumentation on the bridge were analyzed to determine the pile driving impact on existing bridge foundations. Lateral ground movement at the edge of the existing abutment due to pile driving

was predicted to be approximately 0.4 in (10 mm) from original geotechnical analysis. Utilizing the measured inclinometer movements and proximity factors, additional finite analysis determined that soil movement at the closest existing pile was approximately 0.6 in (15 mm), on average. With expected soil movements above original design tolerance, the instrumentation data at the abutment was analyzed in relation to structure tolerance of +/-0.5 in (12 mm) total settlement or heave, as set forth in the project specifications. After pile driving, the data from the inclinometer indicated no additional movement, the abutment structural monitoring prism indicated no settlement nor heave, and nearby tilt sensor data showed no rotational movement, allowing construction and bridge service to safely continue.

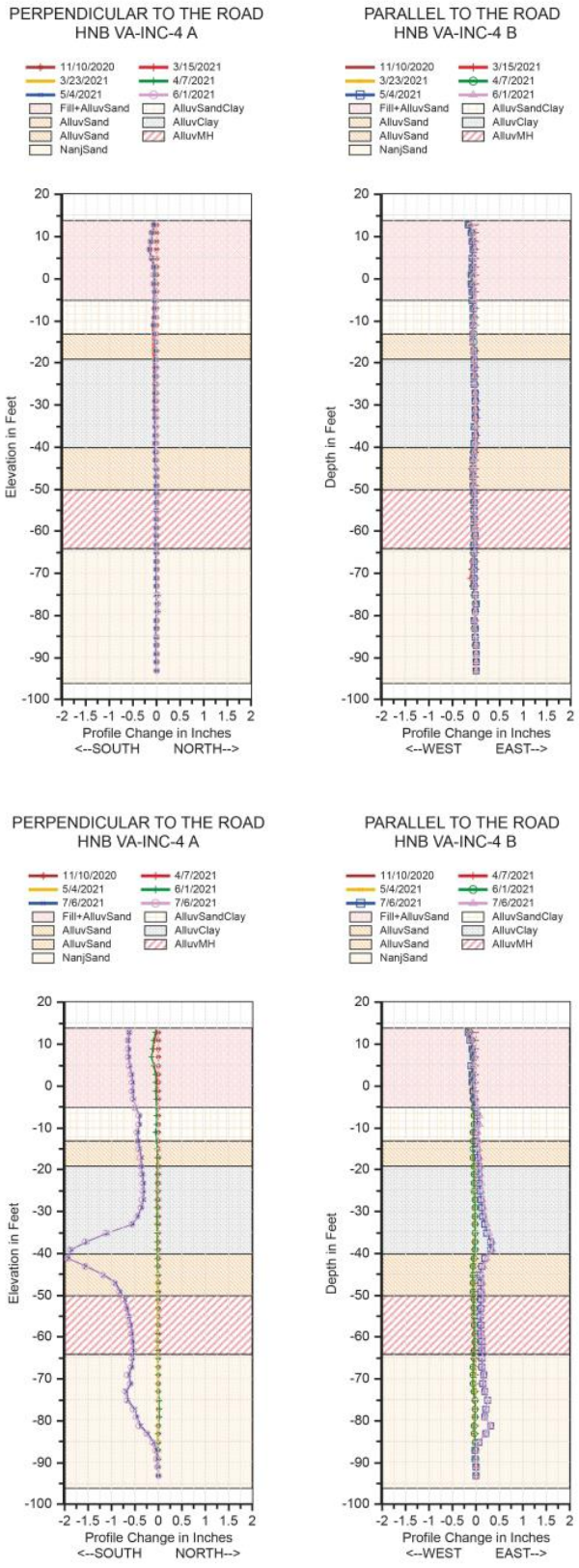
As the project evolved into phases of simultaneous superstructure and substructure installations on the critical path, an unanticipated construction risk factor developed. Adjacent to existing bridge pier 14, steel fender pile driving operations and new pier column concrete pour were scheduled to occur within 50 ft (15 m) of each other on the same day. The concern was that pile driving at that proximity would induce excessive vibration of freshly placed concrete. In a realtime collaboration with the project team, FTG coordinated a vibration monitoring plan for the new column to measure the impact of the pile driving. A vibration sensor was installed on the formwork of the new column to be poured to record data continuously throughout the concrete pour and during the initial 24-hour curing period. Peak particle velocity design tolerance of 0.25 in/s (6 mm/s) was established for fresh concrete with considerations to drive energies and wave velocity paths through new and existing piles within the fender-to-pier cap layout. Vibration readings were monitored during and after the pour for verification of vibration impact within tolerance. Collaboration of all project team members determined that pile driving could continue safely adjacent to the newly placed column without the threat of damage and that the column was not subject to adverse amplitudes.

Conclusion

The data acquired through geotechnical instrumentation monitoring demonstrated that the two high-risk construction activities on the project, pile driving and embankment fill operations, did not have any long-term impact on the existing bridge over a 2.5-year monitoring period. As demonstrated by the discrete events highlighted above, minor effects of construction were seen, but did not trigger alerts set in place for the protection of the existing bridge and its components. Instead, it was found that weather, traffic and debris were the primary causes of alerts generated by the instrumentation, with seasonal and daily temperature fluctuations having a measured effect as well.

Pier 14 fender pile driving and new column pour operations

Successful monitoring of the health and performance of a bridge beyond its intended service life was achieved through the careful planning and utilization of selected instruments. Deploying each instrument for a specific purpose avoided overcollection of data and maintained a manageable level of daily evaluation. The use of various overlapping instrument types in similar areas allowed FTG to continually assess trends and limit risk to public safety.



Inclinometer readings of VA-INC-4 before and after nearby pile driving activities

The value of geotechnical instrumentation monitoring is demonstrated by what does not occur, and is unique to each type of structure, the work being performed and conditions surrounding it. For the Harry Nice Bridge, owners and contractors were able to lean on an experienced team of geotechnical engineers to manage bridge foundation integrity while the project remained on schedule. The new bridge successfully opened in the fall of 2022.

(Deep Foundations, MAR/APR 2023, pp. 17-18, https://www.nxtbook.com/dfi/DEEP-FOUNDATIONS/march-april-2023/index.php#/p/Intro)

Fehmarnbelt: the technology behind the world's longest immersed tube tunnel

Lucy Barnard

Historically, immersed tube tunnels (IMTs) have been seen as a third option behind bridges and bored tunnels, but the record-breaking €7.1bn Fehmarnbelt Tunnel is helping to change all that. *Construction Europe's* Lucy Barnard looks at the cutting edge technology being used to build the world's longest IMT.

Visible for miles around as clusters of orange tower cranes and huge yellow excavators standing out against the long grey mudflats topped with January snow and the greyer waters of the Baltic Sea, construction work is in full swing on the Fehmarnbelt Tunnel, a road and rail mega tunnel set to connect Demark and Germany.

The work harbour and tunnel factory in Rødbyhavn, Denmark

Jens Ole Kaslund, technical director at Femern A/S – the body charged with building the 18km long tunnel – nods enthusiastically when asked about the challenges involved in such a project.

"We will be beating two world records by constructing the world's longest immersed tunnel and the world's longest combined road and rail tunnel," he says proudly. "That is in itself an impressive construction and engineering achievement."

With construction of the record-breaking €7.1bn project now heading into its third year and scheduled to be completed in 2029, engineers around the world will be watching progress with interest, eager to see further applications for the construction techniques and technologies being put into practice in the Fehmarnbelt.

Kaslund, a former project director at Danish rail group Banedanmark, has been working on the project for the last five years and has had overall responsibility for its success since 2019. He says he jumped at the chance of taking the role at the specially-created subsidiary of state-owned Danish transport company Sund & Bælt.

"When I got the opportunity to be part of this amazing project and be part of connecting Scandinavia and central Europe with the longest immersed tunnel in world, I was not a second in doubt," he grins.

Immersed tunnels

Used since the 1890s as a quick and cheap way of building channels for transport and utilities under rivers and harbours, immersed tube tunnels have historically been seen as a third-choice option for most major infrastructure projects, behind bridges and bored tunnels.

The Fehmarnbelt Fixed Link will stretch between Rødbyhavn on the Danish island of Lolland and Puttgarden on the German island of Fehmarn. Map: Femern A/S

Certainly, the Danish government, which is providing the lion's share of the development funding, initially planned to complete the rail and road link via a striking cable-stayed bridge similar to the Øresund Bridge, to the east of the country, which connects Denmark with Sweden via a combined railway and motorway bridge, and which opened in 2000.

However, as design teams started to consider the plans in detail, they began to worry that any structure built across the 18km Fehmarn Strait would be vulnerable to prevailing east-west winds and would create a high risk of shipping collisions.

A second option, which would have been drilling under the sea floor using a tunnel boring machine (TBM) similar to the Channel Tunnel between Britain and France, was also ruled out because the seabed was deemed unsuitable for drilling. The depths involved would have made it difficult for high speed trains to get across without significantly expanding the length of the tunnel and the requirements for dual track train and motorway shafts would have necessitated the use of multiple TBMs, making the project much more expensive.

Instead, in 2011, the design teams finally opted to build an immersed tube tunnel (IMT), an undersea tunnel comprising prefabricated segments fitted together. This is the type of tunnel used for the 4,050m Drogden Tunnel which forms part of the Øresund crossing, linking an artificial island at the end of the bridge with Amager Island in Denmark.

"The immersed tunnel solution has many advantages," Kaslund says. "It is economically more feasible; a tunnel is not affected by weather; it can be constructed almost without interfering with the extensive [shipping] traffic through the Fehmarnbelt; the environmental impact on marine life is less; and we have a lot of experience with immersed tunnels from other Danish projects such as the Øresund Link and Storebælt link. Further, the immersed tunnel was evaluated to be less risky compared to a bridge solution."

Technically challenging

Less risky it may be, but the project comes with its own set of technical challenges. For one thing, there is the scale: the tunnel will be nearly three times longer than the IMT section of the Hong Kong-Zuhai–Macau Fixed Link, currently the longest tube tunnel in the world,

To build such an enormous project, Femern A/S has spent two years preparing the site, constructing a specially built harbour capable of receiving up to 80,000 tonnes of material deliveries each week, accommodation for 1,300 workers and,

even more impressively, the world's largest tunnel factory where the concrete tunnel sections will be made.

Project details

Client: Femern A/S, a specially-created subsidiary of Danish state-owned transport company Sund & Bælt.

Contractors: Fehmarn Belt Contractors (FBC), a joint venture between Boskalis and Van Oord has been conducting the main dredging and marine work. The Fehmarn Link Contractors (FLC) consortium, which includes Vinci, BAM, Per Aarsleff, Wayss & Freytag Ingenieurbau and Max Bögl Stiftung, has been constructing the tunnel, the portal buildings, the casting factory and workers accommodation since January 2021.

Cost: The Fehmarnbelt link's overall financial framework of DKK 55.1 billion (€7.1bn) was determined in the 2015 Construction Act. Of this, DKK 7.3 billion is reserves.

Tunnel size: The tunnel will have a 17.6km immersed section and will be 42 meters wide. Its foundation depths will reach more than 40 meters below sea level. It will comprise five tubes: two 2-lane motorways for cars; two electrified rail tunnels; and one emergency corridor.

Construction timing: Enabling works started on the project on the Danish side in 2020 and the German side in 2021. Dredging of the tunnel trench and construction of the factory began in 2021. The first tunnel segment is expected to be laid before summer 2024 and the project is scheduled to complete in 2029.

This facility, which is currently undergoing its finishing touches, is located close to what will be the Danish tunnel entrance in Rødbyhavn, and is set to be the biggest factory building in Denmark. It will eventually cover around 1 million square metres and have six production lines on which 89 huge tunnel sections, each 220m long and 40m wide and weighing a whopping 73,000 tonnes, will be cast. Divided into three production halls, currently Hall B is 95% complete with its first production line ready to start casting the first segment. Halls A and C meanwhile are expected to be finished later this year.

The elements will be cast step-by-step in segments of approximately 24m in the factory. Because the tunnel sections are so big, they will actually be made in pieces so that each standard element will be made up of nine segments.

To reduce both construction time and complexity, Kaslund says the design team attempted to produce the largest sections feasibly possible, which they could cast safely in one sitting without risk of cracks, based on experience from other immersed tunnel projects and similar casting technology on other projects.

And, for the plan to work, each massive segment must be made in the factory to exactly the right specifications.

Concrete casting

Each segment is cast from layers of concrete built up on top of each other in a manner Kaslund likens to "baking an enormous advanced cake."

Casting each segment according to a detailed plan takes 36 hours of continuous pouring and can be painstaking as workers must ensure that the concrete is exactly the right temperature and consistency – not too cold, not too hot, not too wet and not too dry - before moving on to the next layer and the next.

"The greatest challenge lies in ensuring the quality of the casting," Kaslund says. "Each element comprises nine segments and each segment needs precision in the casting. The production of the element is done in a climate-controlled environment to ensure the highest quality possible."

Illustration of the work harbour. Femern A/S

In fact, the tunnel elements are so large that there is no facility big enough to store them, meaning that as soon as each one is completed it must be taken out to sea and installed straight away.

With so much at stake during the casting, Kaslund and his team have opted to try out the process by having a couple of trial runs. To do this they have built a massive test bed facility where they have had a go at prefabricating blocks containing one and a half rail tube segments.

During the final months of 2022 they completed two blocks of 1½ rail tube segments, ensuring that casting, concrete, formworks, quality and other important details are exactly the same as they will be in the real segments. Kaslund says the team is "still reviewing the results."

Dredging work

Out in the Fehmarn Belt, dredging work on the tunnel trench has been in progress since mid-2021 and is 70% complete. This work is due to finnish next year to enable the first tunnel segment to be laid in the trench before summer 2024.

The contract for dredging and ground reclamation was awarded in 2016 to Fehmarn Belt Contractors (FBC), a joint venture between Dutch dredging specialists Van Oord and Boskalis.

So far, the dredging team has already come up against a number of unusual challenges, including navigating their way around the wreck of a seventeenth century Danish warship and an unexploded second world war bomb.

A fleet of up to nine different dredgers has been pressed into action on the project. Vox Amalia, a Trailing Suction Hopper Dredge (TSHD) - which entered service for Van Oord in March 2020 - acts like a giant, floating vacuum cleaner, hoovering up debris and transporting it has taken on the bulk of the work. She has been assisted by Fetsy and Manta, two barges purchased by FBC and mounted with specialist Liebherr and Mteck cranes for lifting heavy boulders.

In total, the dredging will result in around 19 million cubic meters of sand, stone and soil, which will be used to build a new 300-hectare beach near Rødbyhavn.

Placing the segments

Once a complete tunnel segment has been manufactured in the factory, it will be rolled out and taken to an upper basin

where it will be fitted with temporary steel bulkheads at both ends to make it watertight and ensure it floats.

Huge doors will close behind it, allowing the basin to then be flooded with water – rather like a lock on a canal. This will allow tugboats to move each section down to the lower basin and then out to sea.

For the crews on the tugboats the challenge is clear – positioning each 217m 73,500 tonne floating concrete tunnel segment in exactly the right spot so that when its ballast tanks are flooded with water, each element will sink 40m to the seabed, landing in the dredged trench next to one another and within 15mm of its target.

"We demand a high degree of precision," agrees Kaslund. "We are talking about kilometre-long distances, so when we dig the tunnel trench and place the individual elements, even small deviations along the way can have great significance. Our work must be extremely precise, so when the last element is placed, we need an accuracy of very few millimetres."

To achieve this, Kaslund says the construction team has developed its own "unique GPS-system" which relies on the latest technology to improve GPS accuracy from the typical range of several metres used in mobile phones and cars to an accuracy of 8mm horizontally and 15mm vertically.

The system is being supplied by Danish company Geoteam, which won an EU tender to supply the reference network for the project in spring 2020. It works by boosting the satellite signals available in the construction area by installing 10 stationary terrestrial Global Navigation Satellite Systems stations (GNSS stations).

As anyone using a modern car SatNav system knows only too well, satellite signals to Earth can be weak and quickly run into disturbances, leading to inaccuracies. The GNSS stations, which are located on both the Danish and German sides of the Fehmarn Belt, correct for errors in the satellite signals so that construction machinery and ships can navigate with high accuracy. (Four of the stations have been built by Femern A/S and six by Geoteam.)

Kaslund says that by eliminating these errors, the positioning system can provide tugboat teams with the exact coordinates necessary to lower the tunnel segments into position.

So far that hasn't been tested for real because the first tunnel segments are expected to be placed later this year. However, Kaslund says that the system has already been used for more than a year by the construction equipment that is helping to build the 500,000 square metre work port.

Gina gasket solution

Kaslund says that during the manufacturing process, one end of each tunnel segment is mounted with a Gina gasket, which is a huge hollow vulcanised rubber fitting designed to sit around the entire end of the segment.

In a process which has changed little over the past 70 years, the Gina gasket is then used to connect the segments forming a watertight seal.

Once an element has been laid in the trench, it is coupled together with the adjacent segment and pulled against it using hydraulic jacks. As the elements are brought together the gasket squashes around the join, forming a small reservoir between the two steel bulkheads. The construction team then gets to work pumping the water out of this reservoir which makes the water pressure on the other end of the element compress the Gina profile which seals the joint.

Later a second rubber seal, known as an Omega seal, is then clamped across the joint on the inside of the tunnel and, once the pressure between the Gina and Omega seals has been tested, the temporary bulkheads are removed.

"At the start of the project we evaluated several possible solutions to improve the existing [Gina] joint technology but we did not find solutions superior to the well-known technology developed slightly from the 1950s," Kaslund says. "Also the size of the tunnel project was assessed to be too long to try a new technology before testing it in smaller scale."

The process continues until all the elements are in place. Then, Kaslund says, they will be secured in the tunnel trench with gravel and sand and covered with a protective layer of stone which will be level with the existing seabed.

Once that is complete, the construction team can begin work on the tunnel's technical and mechanical installations such as railway tracks, ventilation, cameras, communication systems, signage and painting, which then must be thoroughly tested before the tunnel's expected opening date of mid-2029.

+100 year design life

Kaslund says that once in operation, the Fehmarnbelt Tunnel has been designed to be used for well over a century, justifying the €7.1bn cost.

Femern A/S hopes to recoup that cash by charging car drivers a toll – likely to be set at close to the rate for the ferry crossing, which is currently around €100.

And, by halving journey times between Scandinavia and Central Europe, Femern predicts that the tunnel will be so popular that it could be $4bn in profit after just 50 years.

By providing a viable 'green' alternative to flying, the tunnel can also justify the huge carbon cost involved in its creation. And, as technology continues to evolve to include more powerful EV batteries and electrified roads that recharge cars' batteries as they drive, Kaslund predicts that demand could be even greater.

"The tunnel will be built to last at least 120 years so the project will pay itself back CO2-wise many times over in its lifespan," he says.

"This is based on today's technology in the car fleet and the ferries and our traffic model prognosis. New developments of transportation technology within the next 10-20 years such as e-roads would therefore have a positive effect on the payback time."

(CONSTRUCTION Europe / 09 March 2023, https://www.construction-europe.com/8026016.article?utm_source=newsletter&utm_medium=email&utm_campaign=Construction-Briefing-10th-march-2023-Final)

What Turkey's earthquake tells us about the science of seismic forecasting

Shannon Hall

Geologists knew decades ago that a quake would strike southeastern Turkey, but precise prediction is still the stuff of science fiction.

The magnitude-7.8 earthquake in Turkey last month destroyed many buildings, such as this one in the city of Kahramanmaraş.Credit: Adem Altan/AFP via Getty

Two decades ago, John McCloskey drew a red line on a map of southeastern Turkey to pinpoint where a large earthquake would probably strike. The only question was when.

The answer came last month, when a magnitude-7.8 shock hit the precise location that McCloskey and his team had identified. It struck at 4.17 a.m. local time on 6 February, when most people were asleep, and killed more than 50,000 residents in Turkey and neighbouring Syria.

McCloskey's work shows both the promise — and limitations — of the science of earthquake forecasting. Although geologists have long attempted to provide warnings of the location, magnitude and exact time of future quakes, decades of research have shown that it's probably impossible to predict when a geological fault will start to shake. "When you try to winnow it down to know what's going to happen next, it tends to be a lesson in humility," says Susan Hough, a geophysicist in the Earthquake Hazards Program at the United States Geological Survey (USGS). "The real focus in most of the world is not on prediction, but on assessing the hazard and the long-term rates of earthquakes."

Today, researchers work on forecasting: identifying which fault segments are most dangerous and what size earthquakes they are expected to produce. Armed with that knowledge, policymakers can take steps to reduce death and destruction by, for example, requiring better building practices or urging local residents to prepare. Some regions of Japan, the United States and Turkey have developed early-warning systems that alert residents when an earthquake has started nearby. "In principle, you can get rid of seismic risk," McCloskey says.

Danger zone

Turkey is a seismically active junction at which several pieces of Earth's crust meet and grind against each other. In southeast Turkey and northern Syria, the Arabian plate is pushing north against the Anatolian plate, squeezing it to the west. But the shift isn't one smooth movement. Instead, friction holds the plates in place, sometimes for centuries. When the stress overcomes the friction, the plates on either side of the fault line will shudder past each other, releasing tremendous energy in the form of an earthquake.

This has happened time and time again in Turkey — a history that allowed McCloskey and his colleagues to map the stresses along one of its major quake sources, the East Anatolian fault. Like other faults, it is divided into segments that slip at different times. When one segment shifts and shakes, it alters the stress on neighbouring sections of the same fault and other faults nearby. That increases the stress in some places, bringing them closer to failure, but relaxes stress on others — making them safer for the time being.

"They are not just randomly occurring earthquakes," says Ross Stein, chief executive of Temblor, a company specializing in seismic hazard and risk assessment. "They are in a conversation. And that conversation is carried out through stress transfer."

In 2002, McCloskey (now a geophysicist at the University of Edinburgh, UK) and his colleagues used this technique to diagnose regions on the East Anatolian fault that were highly stressed. With the help of historical records, the team incurporated the stress changes caused by ten earthquakes since 1822 into a model of ongoing plate movement. The modelling suggested that a region of the fault line south of Kahramanmaraş — the precise location and length of the fault that ruptured on 6 February — was at a heightened risk of giving way at some point in the future[1]. The team even knew that it would be devastating, forecasting a quake of magnitude 7.3 or higher. "The correspondence is remarkable," McCloskey says.

A fracture cuts across a road in the Kahramanmaraş region of Turkey after two strong earthquakes on 6 February.Credit: Utku Ucrak/Anadolu Agency via Getty

It isn't the first time that this method, technically known as Coulomb stress transfer, has accurately pinpointed an upcoming trembler. In 1997, Stein and his colleagues analysed the earthquakes that had already struck Turkey's North Anatolian fault to estimate that the next might occur near the city of Izmit[2]. Two years later, that quake arrived — killing more than 17,000 people. In 2005, McCloskey and his colleagues calculated that the shift in stress after the 2004 Sumatra–Andaman quake in Indonesia might cause one in the Sunda trench west of Sumatra[3]. It came 12 days after the study was published. And in 2008, Shinji Toda from the Geological Survey of Japan in Tsukuba and his colleagues projected that the Wenchuan earthquake earlier that year in China would increase the stress of three adjacent faults[4]. In the following decade, two of those faults unleashed powerful earthquakes.

Added stress

It isn't possible to use the technique everywhere. Because this model requires some knowledge of previous earthquakes, often centuries in the past, researchers can use it to assess only regions where the seismic history is well known. So it is most successful in forecasting aftershocks, which are typically smaller than main shocks. Still, there are many unknowns, and scientists are working hard to evaluate the model further.

In 2002, Tom Parsons, a geophysicist at the USGS, analysed more than 2,000 earthquakes with magnitudes of greater than 5.5 that occurred after — and near — quakes larger than magnitude 7. He found that 61% of the later quakes were associated with an increase in stress caused by the earlier ones[5]. The findings suggest that Coulomb stress transfer can accurately identify faults that are more likely to cause damaging quakes, he says. Then, in 2008, Parsons and his colleagues published a forecast following the Wenchuan earthquake with the intention of later evaluating the model's performance[6]. That work is ongoing.

Today, Stein, one of the researchers who developed the theory about how forces shift after earthquakes[7], estimates that the method has been used in 30,000 papers to explain two-thirds of our planet's recent aftershocks and progressive main shocks. "That tells us this is not the only game in town," Stein says. "Faults are grungy, messy features and they don't behave as we would like them to."

McCloskey's model, for example, anticipated the location of the recent Turkey earthquake, but the shaking started on a much smaller branch of the fault and then spilt over to the main part, a pattern that Stein finds baffling. Another complication is that the main earthquake was also much larger than anticipated, probably because it re-ruptured a segment to the south that broke in 1822 and a segment to the north, which broke in 1893.

"This really underlines the problem of earthquake forecasting," McCloskey says. "Even when we identify the place that is most dangerous, every earthquake is unique."

Not long ago, seismologists thought they might be able to predict some quakes days or hours before they strike. Such hopes emerged from Parkfield, California, where earthquakes had rocked a small part of the San Andreas fault nearly every 22 years. Each of these quakes followed a smaller shock to the north. And hours before a strong quake near Parkfield in 1966, precursory movement had broken an irrigation pipeline that crossed the fault.

"In 1966, earthquake prediction looked like it was ours to have," Stein says. Before the next anticipated earthquake, geologists wired the area with hundreds of seismometers — hoping to find some harbinger that could be used to forecast future quakes. But when the next quake hit, researchers saw no warning signs.

Other precursors have similarly vanished. Over the years, scientists have analysed increasing amounts of radon in local water, electromagnetic signals from Earth's crust and even odd animal behaviour. But none of these potential precursors stood up to statistical tests. "Despite all kinds of startling, promising shreds of evidence, we haven't made an iota of progress toward actually predicting earthquakes," Stein says.

McCloskey doesn't think that it will ever happen. And Hough, who wrote a book called *Predicting the Unpredictable* (2009), argues that most geologists in the West don't even work on it — at least, not any more. "We know how unlikely it is that suddenly something is going to show up that we can see before every big earthquake," Stein says.

Even though geoscientists can't predict quakes with any precision, many researchers say it is possible to prevent much of the death and destruction from these natural disasters.

After the 1999 earthquake in Izmit, Aykut Barka, a geologist at Istanbul Technical University, warned that the increased stress could trigger a similar rupture near Düzce, a town roughly 100 kilometres east[8]. His work persuaded the authorities to close school buildings that had been damaged by the Izmit shock. When a magnitude-7.1 earthquake struck the city 2 months later, the buildings collapsed.

Early warnings

Earthquake forecasting could help in other regions as well. California, for example, which is home to the massive San Andreas fault, has implemented the beginnings of an early-warning system that relies on networks of seismometers to detect the very start of a quake. That can provide seconds or minutes of advance notice to Californians to 'drop, cover and hold on' while automatically triggering life-saving measures such as slowing trains to a stop.

In 2002, Turkey implemented an early-warning system in Istanbul that will slow trains, open lift doors and shut down critical processes in factories in the case of an earthquake. The country has also implemented building codes, but many scientists were concerned that they weren't being enforced rigorously enough. Mustafa Erdik, a retired civil engineer at Boğaziçi University in Istanbul and president of the Turkish Earthquake Foundation, agrees that this was the case — arguing that ignorance, incompetence and implicit collusion between architects, inspectors and builders were at fault.

That makes February's aftermath particularly painful for those researchers who have been sounding the alarm for years. "You put a red line on a map, and you understand that means lots of people are going to be killed and their houses destroyed," McCloskey says.

"The Turkey earthquake to me is, of course, a complete tragedy," he says. Yet McCloskey is hopeful that we will learn from it. If we do, the next red line he draws on a map will not necessarily equal a catastrophic loss of lives.

doi: https://doi.org/10.1038/d41586-023-00685-y

References

1. Nalbant, S. S., McCloskey, J., Steacy, S. & Barka, A. A. *Earth Planet. Sci. Lett.* **195**, 291–298 (2002). Article

2. Stein, R. S., Barka, A. A. & Dieterich, J. H. *Geophys. J. Int.* **128**, 594–604 (1997). Article

3. McCloskey, J., Nalbant, S. & Steacy, S. *Nature* **434**, 291 (2005). Article

4. Toda, S., Lin, J., Meghraoui, M. & Stein, R. S. *Geophys. Res. Lett.* **35**, L17305 (2008). Article

5. Parsons, T. *Geophys. Res. Lett.* **107**, 2199 (2002). Article

6. Parsons, T., Ji, C. & Kirby, E. *Nature* **454**, 509–510 (2008). Article PubMed

7. Stein, R. *Nature* **402**, 605–609 (1999). Article

8. Barka, A. *Science* **285**, 1858–1859 (1999). Article

(Nature, 06 March 2023, https://www.nature.com/articles/d41586-023-00685-y)

Father of BIM: 'AI will one day be able to design a building for you'

Dr Jonathan Ingram has become known as the 'father of BIM' for designing and writing the first building information modelling (BIM) systems, including Sonata and REfLEX.

He also taught the first BIM courses at Harvard University and won the Prince Philip Gold Medal from the Royal Academy of Engineers for his work.

He tells Neil Gerrard how artificial intelligence (AI) and augmented reality (AR) could revolutionise the way construction professionals design and build buildings – and what needs to change before that happens.

Why has BIM become so important to construction?

There were a number of problems with construction before BIM. One was the co-ordination of information.

Dr Jonathan Ingram (Image courtesy of Jonathan Ingram)

You would have separate plan drawings, elevation drawings, and quantities being done by different groups of people in different offices and there was no physical link between them.

This could lead to expensive errors, for example, the windows being in the wrong place. That information needed to be coordinated.

BIM provides consistent information in terms of drawings and physical data.

Data is not duplicated in a true BIM system. You have one source of data, which is correct.

Engineers, architects, services workers all work in their own silos.

BIM enables them to share their space, which is critical to the design.

It is instantaneous and interactive.

This enables the design process to be shortened, guaranteed to be correct, and gives you more opportunity to correct as you go along.

It means zero changes in the construction.

You have written a book called 'Understanding BIM: The Past, Present and Future'. Does that mean that you feel BIM is not yet well enough understood among construction professionals?

BIM has become complicated.

Basic BIM is really quite straightforward but what has happened is that it has been added to and added to and many modern BIM systems have become overengineered.

The core system has not changed fundamentally from the code I wrote in 1992-3.

But it is difficult to understand because it has become so complex. In my book, I am trying to show why BIM exists, how it evolved, and where it is going in the future.

I am currently working to apply information modelling into retail. We have a successful American company called 345.global where we apply all these information management (IM) principles to retail.

We also use artificial intelligence (AI) and augmented reality (AR).

How would you rate the construction industry's progress in terms of taking up digital tools like BIM?

They have done well enough. I don't blame the construction industry for the slow progress, it just too difficult and to some extent too specialist and heavy for your average designer.

It has been 40 years and it was a very hard sell in the early days, trust me.

When you have various people using a system, it is very easy to get the next person to use the system.

When no-one is using it, then finding people to use a system which is meant for sharing is hard.

But BIM needs a good rewrite to bring it into the modern environment and to make it comprehensible, intuitive and powerful.

How does BIM need to evolve for the modern environment?

You want an interface which is modern, simple, which is web-based rather than on heavy lumps of code.

You want a cloud-based shared database.

And you need to have a truly open system.

Having the **Industry Foundation Classes (IFC)** and **Construction Operations Building Information Exchange (COBie)** helps but you need to have an open database to truly progress.

You want to be able to let the AI guy do the optimization or to add his bits around that. But if you only allow IFC, which is basically a 3D model, you are losing information from the BIM.

A BIM model is a lot more than a 3D model. For instance, it includes connectivity between the objects; A window needs to know it is in the wall and the wall needs to know the shape of the window, what type of closures and so on. The ducts need to know they are talking to each other and how they are connected.

To move forwards, this type of information needs to be made available and the only true way to do that is with an open database.

You have talked about wanting to harness new technologies to make BIM into a 'fully cognisant' system in the future. What does that mean for construction professionals?

I have spent the last couple of years writing code and designing systems to do with artificial intelligence (AI) and augmented reality (AR) in retail BIM.

These new technologies provide a wonderful toybox of what you can do in construction in the future.

A screenshot from Ingram's book showing a Sonata image of the National Tennis Stadium by Jeff Findlay from 1987. (Image: Peddle Thorp Melbourne)

You want to be able to say to the system: "Design me a building that looks like it was designed by Richard Rogers".

I was using [AI image creation system] **DALL.E** the other day and said: "Design me an aircraft carrier that looks like it was designed by Richard Rogers."

I tried it with buildings too and unfortunately it is not there yet.

I have also been playing with **ChatGPT** to try to work out its possibilities as a serious tool.

Those tools aren't there yet but they are coming.

Soon, AI and AR will be able to help design the building and check what you have done.

I am a great believer the human voice rather then going through multiple confusing menus.

In the future, you will be able to ask the system: "How do I do this?" or "Show me the windows I used in the last project."

At this very minute I am doing coding with Google Dialogflow, which is an intent-based voice recognition system. It brings huge possibilities as to how systems can be improved.

How do you feel about your reputation as the 'father of BIM'?

I am very proud of the work I have done.

I have sweated with many projects over several systems and several decades.

At the very beginning I sat alone (in an attic) writing the code for the first BIM system, Sonata, and that system was in use until 2015, helping to complete many thousands of major projects around the world.

I am very pleased and proud to be known as the father of BIM and I am continuing to work on progressing information modelling into the future.

(Neil Gerrard / INTERNATIONAL CONSTRUCTION, 13 March 2023, https://www.international-construction.com/8026108.article?utm_source=newsletter&utm_medium=email&utm_campaign=Construction-Briefing-14th-march-2023-Final)

What are the limits to building even taller sky-scrapers?

Neil Gerrard

Even as speculation continues around whether or not the 1km-tall Jeddah Tower in Saudi Arabia will ever be finished, plans are already afoot to build a **2km-tall skyscraper** in the kingdom.

Burj Khalifa, Dubai (Photo: AdobeStock)

A 2km-tall building would exceed the world's current tallest building, the 828-metre-high Burj Khalifa, by nearly 1.2km. And the Burj Khalifa is itself more than 300m higher than the 508m-tall Taipei 101, which was previously the world's tallest building.

Such huge increases in height beg a question: are there limits to building supertall buildings and what governs those limits?

Limits aren't technological

Peter Weismantle, consulting director of supertall building technology at architecture firm at Adrian Smith + Gordon Gill Architecture based in Chicago, has decades of experience working on tall buildings.

He was part of the team at Skidmore, Owings & Merrill (SOM) that designed the 88-storey Jin Mao tower in Shanghai. In 2003, he took on the role of senior technical architect for the Burj Khalifa. And having left SOM to join Burj Khalifa architect Adrian Smith, he helped to design the Jeddah Tower.

Thanks to his wealth of experience, Weismantle understands a thing or two about the technical design of super high-rise buildings. And in his view, the construction sector has the capability to build buildings up to 2km and beyond. But other factors get in the way first.

"I don't think the limits are technological. First is money and the economics of these tall buildings," he says.

"In order to build tall, you have to build a big building in the sense that it has a lot of area – a lot of surface area and a lot of floor area. That is money. And the taller you go, the more the cost per square metre goes up."

Tied to the cost of building buildings at such a huge scale is the amount of time it takes – and time also means money. "In order to build these things anywhere near efficiently, you have got to build them quickly. And quick for a supertall means about five years. That is a long time, especially now with inflation the way it is," he adds.

Then come constraints related to the human body. The first signs of altitude sickness can start to appear after at least four hours spent above 2,000m.

"When you fly from Chicago to Denver you are going up to 5,200ft (1,600m). It takes you a day to acclimate and it is not unusual to get headaches and to feel tired," says Weismantle.

A two-minute elevator trip from sea level up to 2,000m could therefore stress the human body. Weismantle suggests that one solution could be to pressurize the building but warns that aside from not being easy to keep exterior walls completely airtight, it would consume huge amounts of energy.

"If you are going to build a building like that, you had better make sure it is a vertical city where you don't have to keep going from ground level to your apartment or office. You want to live within a zone. But people don't want to be sealed in their building all the time, they want to get out. So that is one of the biggest constraints."

Materials and foundations

Financial and physiological limitations aside, Weismantle is more confident about the technical capabilities of designers and construction companies to deliver even taller buildings. He calls 2km "pretty reasonable". "Is it the limit? I doubt it," he adds.

Construction on the 1km-tall Jeddah Tower has stalled but there are plans for a 2km-tall skyscraper in Saudi Arabia (Image: Adobe Stock)

Burj Khalifa's "buttressed core" structural system involves concrete walls arranged in a hexagonal hub, each of them buttressing the others.

Weismantle sees concrete as the go-to material for supertall construction, largely thanks to its weight. "Weight is a good thing in a tall building because it counteracts some of the wind forces. In tall buildings, even in earthquake zones, you design for the wind. And if you can design for the wind then the seismic usually takes care of itself," he says.

"When the wind hits a building, it excites it perpendicular to the direction of the wind because of the vortex shedding. Concrete is really good because of its mass – it gives a natural dampening."

New York, where Weismantle grew up and where he first became fascinated by tall buildings, benefits from hard, metamorphic bedrock that is perfect for bearing the weight of heavy skyscrapers.

But geotechnical conditions elsewhere in the world mean that the foundations for supertall buildings require extensive construction work. In the case of Burj Khalifa and Jeddah Tower, there is no bedrock near the surface so both sit on a foundation system of friction piles with a 4m-deep mat foundation above that connects all the piles. In the case of the Jeddah Tower, the friction piles were 105m deep. While technically feasible, such conditions again add to the cost.

Ahmad Abdelrazaq is the former head of the high rise and complex building division at Samsung C&T Corporation, before he left to found his own practice Rise Global. He worked at SOM on the design of the Burj Khalifa before joining Samsung to build the project. He was also involved in the 679m-tall Merdeka 118 in Kuala Lumpur, Malaysia, making him responsible for the design and build of the world's tallest and second tallest buildings.

He points out that while normal-weight concrete is currently the norm, ultra-high-performance materials like steel-fibre reinforced concrete can make buildings lighter at the same time as giving higher stiffness, higher tension and higher strength. Although he admits that building codes have not yet caught up with what high-performance materials can do, placing a limitation on how construction teams are allowed to use them within buildings.

Nonetheless, he has worked with students at Seoul National University in South Korea, where he is visiting professor, to consider how existing supertall towers could be redesigned to take account of new materials and construction methods.

In the case of the Jeddah Tower, constructing the building in the same arrangement but using fibre-reinforced concrete could, he claims, reduce weight by 30%. That has implications not just for reducing the embodied carbon in the building but would also make it stronger and more durable, as well as more resistant to earthquakes because seismic load on a building is dependent on its weight.

Using new technology to keep costs down

As materials and labour, even in developing countries, becomes more expensive, Weismantle expects construction to adopt anything that can increase labour productivity and reduce wastage.

He wants to see greater leveraging of BIM technologies. "If you can literally build the building in the machine and then you can get those components into a factory, that is where maybe there will be some further developments. But everything [in construction] is such a one-off that it is hard to generate the economies of scale we need," he says.

While Abdelrazaq also sees no limits on how tall a building can be, he does see the need to modernize the ways in which they are designed and constructed.

He says, "We have to find ways of building supertall buildings more economically and more sustainably. As you increase the scale of a building, you can no longer look at the traditional solutions. We need to come up with an alternative structural system tailored to deal with these very tall buildings.

"You are creating a vertical city and the question is how do you create these cities and communities. Right now, we have a lot of limitations in terms of equipment and how far it can go.

"So you need to start looking at different methodologies and mechanizing the construction process – in other words creating working platforms that can climb up the building."

He also sees modular construction as key to speeding up construction work and reducing the reliance on large workforces.

Merdeka 118 in Kuala Lumpur, Malaysia during construction in 2021. It is now the world's second-tallest building (Image: Adobe Stock)

"At Burj Khalifa, we had 12,000 people working on the building, which was way too much. You don't want to have that many people working on site so you need to start looking at phased planning and construction, and start looking at offsite construction and delivering things when they are complete.," he says.

Finally, one area where Abdelrazaq thinks supertall buildings are "missing the boat" is energy generation.

"People have talked a lot about solar chimneys, energy towers and so on. Here you are building a building where you have the opportunity to do this. There is no reason why something like this cannot generate its own electricity. With some of the very tall ones, you could generate more power than is required by just the building itself."

(international construction, 07 March 2023, https://www.international-construction.com/8025998.article)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular March 2023

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

1. NEW ISSMGE INTERACTIVE TECHNICAL TALK AVAILABLE FROM THE ISSMGE WEBSITE

ISSMGE Interactive Technical Talk Episode 4: Environmental Geotechnics (TC215)

ISSMGE Interactive Technical Talk Episode 5: Sustainability in Geotechnical Engineering (TC307)

2. LIFETIME ACHIEVEMENT MEDAL

For details of this new award, see https://www.issmge.org/news/issmge-lifetime-achievement-medal-announcement-and-call-for-nominations Nominations must be received by 15 April 2023.

3. ISSMGE SECRETARY GENERAL

The President, Professor Marc Ballouz, is pleased to announce that Dr Andrew McNamara will be appointed as the new Secretary General of ISSMGE. Dr McNamara will take up the appointment after the next ISSMGE Council Meeting on 13 August 2023 held in conjunction with the 17th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, Astana, Kazakhstan.

Dr McNamara is a practicing engineer with a strong attachment to academia and research. He is both Chief Engineer, Skanska UK Building and Senior Lecturer in Geotechnical Engineering, City, University of London. He will bring a wealth of experience and leadership to the ISSMGE Secretariat, and we look forward to working with him on the Board of ISSMGE.

4. ISSMGE LEXICON - NEW LANGUAGE ADDED

The ISSMGE interactive electronic Lexicon has been extended to include Greek language for details, see https://www.issmge.org/news/lexicon-now-also-in-greek

5. ISSMGE BULLETIN

The latest edition of the ISSMGE Bulletin (Volume 17, Issue 1, February 2023) is available from the website.

6. ISSMGE FOUNDATION

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 31st May 2023. Click **here** for further information on the ISSMGE Foundation.

7. CONFERENCES

Member Societies, Technical Committees, Sister Societies and related organisations may add their events directly to the ISSMGE Events database via the link + Submit Event at the top pf the EVENTS page

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

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

ISSMGE EVENTS

11TH INTERNATIONAL CONFERENCE ON SCOUR AND EROSION (ICSE-11) - 17-09-2023 - 21-09-2023 Scandic Copenhagen Hotel, Copenhagen, Denmark; Language: English; Organiser: ICSE-11 organizing committee; Contact person: ICSE-11 Secretariat: c/o CAP Partner; Address: Nordre Fasanvej 113 DK-2000 Frederiksberg Denmark; Phone: +45 70 20 03 05 ; Fax: +45 70 20 03 15 ; Website: https://icse11.org/; Email : info@cap-partner.eu

THE SECOND MEDITERRANEAN SYMPOSIUM ON LANDSLIDES 05-10-2023 - 07-10-2023 Hammamet (Tunisia); Language: English; Organiser: Civil Engineering Laboratory (National Engineering school of Tunis, Tunis El Manar University).; Contact person: Fakher HAMROUNI ; Address: Route de gabes km 7.5 Bougacha; Phone: 27283919; Email: fakher.hamrouni@gmail.com; Website: https://msl-2023.webnode.fr; Email: medsymplandslides23@gmail.com;

FIRST INTERNATIONAL CONFERENCE ON GEOTECHNICS OF TAILINGS AND MINE WASTE 24-10-2023 - 26-10-2023 Ouro Preto, State of Minas Gerais, Brazil; Language: English; Organiser: TC221 and Brazilian Geotechnical Society; Contact person: Fernando Schnaid; Phone: +51 3084 4040; Email: fschnaid@gmail.com; Website:-https://geominouropreto.com.br/2023/icgtmw2023/; Email:-rverdugo@cmgi.cl;

7TH INTERNATIONAL CONFERENCE ON GEOTECHNICAL AND GEOPHYSICAL SITE CHARACTERIZATION 18-06-2024 - 21-06-2024 Campus Nord UPC, Barcelona, Spain; Language: English; Organiser: UPC-CIMNE; Contact person: CIMNE Congress Bureau; Address: Campus Nord UPC Building C1 - Office C4 C/ Gran Capità, S/N; Phone: +34 93 405 4694; Email: isc2023secretariat@cimne.upc.edu; Website: https://isc7.cimne.com/

14TH INTERNATIONAL SYMPOSIUM ON LANDSLIDES 2024 - 07-07-2024 - 12-07-2024 Le Manège Congress Center, Chambery, Franc; Language: English; Organiser: JTC1 and national societies CFMS/CFGI/CFMR/INDURA/IREX/USMB; Contact person: Véronique Merrien - François Nicot ; Email: contact@isl2024.com; Website: https://www.isl2024.com/

4TH INTERNATIONAL CONFERENCE OF INTERNATIONAL SOCIETY FOR INTELLIGENT CONSTRUCTION (ISIC 2024) - 10-09-2024 - 12-09-2024 DoubleTree by Hilton Hotel Orlando at SeaWorld, United States; Language:

English; Organiser: International Society for Intelligent Construction (ISIC); Contact person: Patte Hahn; Address: 2857 Jolly Road; Phone: +1 (517) 432-8220; Email: hahnp@egr.msu.edu; Website: https://www.is-ic.org/conferences/2024-isic-international-conference/;

IS-GRENOBLE 2024: INTERNATIONAL SYMPOSIUM ON GEOMECHANICS FROM MICRO TO MACRO 23-09-2024 - 28-09-2024 Maison MINATEC, Grenoble, France; Language: English; Organiser: TC105 Geo-Mechanics from Micro to Macro; Contact person: Cino Viggiani; Email: cino.viggiani@3sr-grenoble.fr; Website: https://is-grenoble2024.sciencesconf.org/; Email: is-grenoble2024@sciencesconf.org

5TH INTERNATIONAL CONFERENCE ON TRANSPORTATION GEOTECHNICS - 18-11-2024 - 20-11-2024 Sofitel Sydney Wentworth, Australia; Language: English; Organiser: Transport Research Centre, University of Technology Sydney; Contact persons: Prof Buddhima Indraratna (Conference Chair) Email: buddhima.indraratna@uts.edu.au; Dr Chamindi Jayasuriya (Conference Secretary); Email: chamindijayasuriya@gmail.com; Website: http://www.ictg2024.com.au;

NON-ISSMGE EVENTS

7TH INTERNATIONAL CONFERENCE SERIES ON GEOTECHNICS, CIVIL ENGINEERING AND STRUCTURES (CIGOS) - 04-04-2024 - 05-04-2024 Ho Chi Minh City, Vietnam; Language: English; Organiser: Association of Vietnamese Scientists and Experts (AVSE Global) and University of Architecture Ho Chi Minh City (UAH); Contact person: cigos2024@sciencesconf.org; Website : https://cigos2024.sciencesconf.org/

THE THIRD INTERNATIONAL CONFERENCE ON PRESS-IN ENGINEERING 2024, SINGAPORE - 03-07-2024 - 05-07-2024 University Town, National University of Singapore, Language: English; Organiser: ICPE2024 Organizing Committee and International Press-in Association; Contact person: ICPE Organizing Committee IPA Secretariat; Address: 5F, Sanwa Konan Bldg, 2-4-3 Konan, Minato-ku, Tokyo 108-0075, Japan; Phone: 81-0354611191 ; Fax: 81-0354611192 ; Email: tokyo@press-in.org; Website: https://2024.icpe-ipa.org/

TC301 website

The Technical Committee TC301 on Preservation of Monuments and Historic Sites has launched its new website accessible through the link: https://tc301-historic-sites.com/

2nd Singapore-Malaysia GeoSS-MGS Conference on Geotechnical Engineering (30 Nov-02 Dec 2023)

Siau Chen Chian / TC217 / 06-03-2023

The 1st Malaysian Geotechnical Society - Geotechnical Society of Singapore Geotechnical Conference was successfully held from 24 to 26 June 2019 with close to 300 participants at Hilton Petaling Jaya, Selangor, Malaysia. The second conference was supposed to be held in Singapore in 2021 but had to be postponed due to COVID-19 pandemic. With the relaxation of COVID-19 safe management measures in both countries, the Joint Singapore-Malaysia Organizing Committee is pleased to announce that the Second GeoSS-MGS will be held in Singapore from 30 November to 2 December 2023.

The Conference will have an Opening Address and Keynote Lectures to be delivered by distinguished geotechnical experts and eminent academicians. Authors from Singapore, Malaysia, and other countries will make presentations at the Conference.

Sustainable urban development was the theme of the first conference and this topic will remain as the key subject matter of the second conference. New challenges have also emerged in both countries. These include tackling climate change, environmental sustainability achieving carbon-neutral, and holistic considerations of cost, time and safety among other issues.

To continue the tradition, this conference will provide the perfect opportunity for the exchange of know-how and lessons learnt between Singaporean and Malaysian geotechnical practitioners, academicians, and authorities, and is certainly not to be missed.

The online portal for submission of abstracts is now open at: https://www.geoss-mgs-conference.com/

We look forward to your contribution and visit to Singapore for the conference.

Conference Co-chairs:

Prof. LEUNG Chun Fai
Dr. Muthusamy KARTHIKEYAN
Ir. LEE Peir Tien

Lexicon now also in Greek!

ISSMGE IT Administrator / General / 09-03-2023

ISSMGE is proud to announce that its interactive electronic Lexicon has been extended to include one more language - Greek. The lexicon, which was launched in an upgraded version in March 2013, now includes terms in 15 different languages, with the help of its members and distinguished professionals.

The work was performed by the Hellenic Society for Soil Mechanics and Geotechnical Engineering (HSSGME) under the guidance of Mr M. Pachakis with its members A. Giannakogiorgos, H. Geli, Th. Gofas, D. Egglezos, G. Belokas, G. Papacharalambous, H. Sakoubenta and K. Sachpazis contributing with translation of terms and M. Pachakis, A. Anagnostopoulos, V. Xenaki, G. Belokas, G. Doulis, G. Gazetas, M. Pantazidou, Ch. Tsatsanifos, P. Vettas, I. Zevgolis and M. Bardanis contributing with final review and homogenisation of the translated terms.

Visit https://www.issmge.org/lexicon to use the lexicon!

ISSMGE Interactive Technical Talk Episode 5: Sustainability in Geotechnical Engineering (TC307)

ISSMGE IT Administrator / General / 15-03-2023

The fifth episode of International Interactive Technical Talk has just been launched and is supported by TC307. Prof. Md. Mizanur Rahman, Dr. Sara Rios and Tone Ratcliffe Smaavik are discussing with Dr. Marc Ballouz about "Sustainability in Geotechnical Engineering"

https://www.youtube.com/watch?v=NXmugV5z3DM

Appointment of the ISSMGE's new Secretary General - Dr Andrew McNamara

ISSMGE Secretariat / General / 13-03-2023

The President, Professor Marc Ballouz, is pleased to announce that Dr Andrew McNamara will be appointed as the new Secretary General of ISSMGE. Dr McNamara will take up the appointment after the next ISSMGE Council Meeting on 13 August 2023 held in conjunction with the 17th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, Astana, Kazakhstan.

Dr McNamara is a practicing engineer with a strong attachment to academia and research. He is both Chief Engineer, Skanska UK Building and Senior Lecturer in Geotechnical Engineering, City, University of London. He will bring a wealth of experience and leadership to the ISSMGE Secretariat, and we look forward to working with him on the Board of ISSMGE.

Neil Taylor
Secretary General, ISSMGE

ISSMGE Lifetime Achievement Medal: Announcement and Call for Nominations

ISSMGE IT Administrator / General / 14-03-2023

ISSMGE, by its Awards committee (AWAC), is announcing the new **ISSMGE Lifetime Achievement Medal.**

The Lifetime Achievement Medal is awarded to a person who, by his/her knowledge, involvement, character and achievements, have made considerable and significant contributions to the geotechnical engineers and the geotechnical practice in his/her country, region or at international level. The award considers contributions over a whole of a career, and for the manner in which their work has touched and shaped the lives and views of many geotechnical engineers.

The nomination is made by the national society member of ISSMGE corresponding to the country of residence of the candidate, via the ISSMGE Vice-President of the corresponding region, who will advise about the received nominations.

Here below you can find the **calendar** and the **procedure**.

Calendar:

Call for candidates: 15.03 - 15.04.2023

National member societies can send nominations until 15.04.2023 23:59 by email to the ISSMGE Secretary General (secretary.general@issmge.org) and to the corresponding regional Vice-president.

Pre-evaluation of candidates by regional Vice-presidents: 15.04 - 15.05.2023

Deadline for pre-evaluated nominations per region to attend AWAC: 15.05.2023

AWAC proposals to ISSMGE board: 15.06.2023

Procedure

Up to two medals are offered yearly, respecting geographic diversity.

The ISSMGE President or its regional representative will present the medal to the nominee in person, in his/hers place during a ceremony to be organized by the national member society.

Nomination of candidates

The candidates should be nominated by the national member societies via the regional ISSMGE Vice-presidents.

The call for candidates will be launched once per year and 2 medals will be awarded every year.

Nominations must reach the Secretary General by the announced date on the ISSMGE Website.

Regional ISSMGE Vice-Presidents will pre-evaluate the candidates and communicate the result to AWAC.

AWAC chooses 1 3 candidates from different regions and submit the proposals to ISSMGE board.

ISSMGE board will decide the recipients of the medal.

The application of the national member society should include:

- A general presentation of the candidate and his/her lifetime activity and achievements with emphasize on the impact of his/her activity on the geotechnical engineers
- Argumentation of the national society for this nomination (2 pages max) based on the criteria here below

Criteria

Eligibility and basic requirements for the award are:

- The proposed candidate should be a known and recognized member of the ISSMGE community in the country or region or at international level, with a lifetime experience and practice and a major influence on the geotechnical engineers
- The candidate should have played a significant role in and made substantial contribution to the geotechnical engineering industry in their country. Examples of contributions in-clude, but are not limited to:
    - dedicated industry leadership,
    - contribution to innovative industry practice,
    - mentorship of young geotechnical engineers,
    - long term contribution to administration, organization and leadership of geotechnical companies.
    - long term contribution to local geotechnical societies;
- The candidate should be alive at the time of the nomination. Particular attention should be given to those who are not able to travel and/or attend international conferences in the field, therefore cannot still present their achievements.
- Limit of 1 nominee per year per member society. If the nominee is not awarded, the national society can nominate her / him to another call in subsequent year(s).

Chair AWAC,
Prof. Loretta Batali

Call for Abstracts: 4th International Society for Intelligent Construction Conference (ISIC 2024)

Jennifer Nicks / TC202 / 17-03-2023

The International Society for Intelligent Construction 2024 Conference (ISIC 2024) will be held in Orlando, Florida, USA, from 10 to 12 September 2024. Intelligent construction technologies (ICT) are combinations of modern science and innovative construction technologies. The International Soci-ety for Intelligent Construction (ISIC) provides a forum for disseminating knowledge concerning the collection, analysis, and application of ICT for infrastructure. ISICs mission is to promote ICT applications to the life cycle of infrastructure (survey, design, construction, operation, and maintenance/ rehabilitation) while adapting to environmental conditions and minimizing risk. ISIC aims to improve construction quality, reduce costs, and promote safety.

The ISIC 2024 conference theme is **Sustainability through Technologies**. The conference topics cover the scope of intelligent construction technologies for infrastructure to **improve sustainability and safety**. The abstract submission is due on 30 May 2023 (around 250 words) through the Springer ISIC 2024 Conference Proceedings Submission System.

Organizer: International Society for Intelligent Construction (ISIC)

Contact Information

- Contact person: Patte Hahn
- Address: 2857 Jolly Road
- Phone: +1 (517) 432-8220
- Email: hahnp@egr.msu.edu

Website https://www.is-ic.org/conferences/2024-isic-international-conference/

Email hahnp@egr.msu.edu

1st International Conference on Geotechnics of Tailings and Mine Waste, 2023

Ramón Verdugo / TC221 / 21-03-2023

ISSMGE launched TC221 on Tailings and Mine Waste, in March 2020, with the aim of playing an important role in promulgating all geotechnical aspects associated with design, stability analysis, construction methods and conditions of closure of the resulting works for the storage of waste materials generated by mining processes.

Because of the pandemic, only online activities have been carried out (two webinars). Fortunately, it seems that now we can say that "normality" is back, so face-to-face events can be done again with little risk. In this context, we are now organizing the first International Conference on Geotechnics of Tailings and Mine Waste, to be held from 25th to 27th, October 2023 in Ouro Preto, State of Minas Gerais, Brazil. The Conference will take place in parallel with the Geomin Symposium, a Brazilian event that attracts different stakeholders and practitioners from the mining industry.

Please see details of the conference in the following link: https://geominouropreto.com.br/2023/icgtmw2023/

We know how difficult it is commonly to organize the agenda for the same year, but this is an event that addresses the key issues related to the stability of TSFs and waste rock dumps, and therefore your participation is definitely very important. We hope that you participate either by sending an article and/or attending this event in person.

ISRM International Society for Rock Mechanics and Rock Engineering

41st ISRM Online Lecture - 23 March - Professor Norikazu Shimizu

The 41st ISRM online lecture will be delivered by **Professor Norikazu Shimizu**, from Japan. The title of the lecture is: "**Monitoring rock displacements using satellite tech-**

nology". It will be broad-casted on 23 March 2023, 10 A.M. GMT at www.isrm.net.

Dr. Norikazu Shimizu is an Emeritus Professor of Yamaguchi University, Japan, and is cur-rently working for the Organization for Research and Development of Innovative Science and Technology, Kansai University, as a Specially Appointed Professor. He started his academic career in the Department of Civil Engineering at Kobe University in 1981. He joined Yamaguchi University as an Associate Professor in 1992 and was ap-pointed as a Full Profes-sor of Rock Mechanics and Rock En-gineering in 2000. He re-tired from Yamaguchi University in 2021.

Professor Shimizu served as a Vice President at Large of the International Society for Rock Mechanics and Rock Engineering (ISRM) from 2015-2019. He was President of the Japan Society for Rock Mechanics and Chair of the Committee of Rock Mechanics in the Japan Society of Civil Engineers from 2011-2013.

Professor Shimizu has received various awards for his contributions to academia and society from the Japanese government: the Japan Prime Minister's Prize for Distinguished Contributor to Disaster Prevention, the Space Development and Utilization Grand Prize by the Ministry of Land, Infrastructure, Transport and Tourism, and the Award of Contribution to Regional Educational Administration from the Ministry of Education, Culture, Sports, Science and Technology. He was also awarded the Meritorious Contribution Award from the Japan Society of Civil Engineers, and Distinguished Paper Award, Technical Development Award, etc. from several academic and professional societies. He was chosen to be an honorary member of the Geotechnical Society of Bosnia and Herzegovina for his contribution to the society.

His research topics are "Development of rock displacement monitoring system using satellite technology and its practical uses", "Numerical analyses and field measurements for assessment of the rock stability of slopes, tunnels, underground large caverns and dams", and "Underground space design using human sensibility". In 2014, he published the ISRM Suggested Method for Monitoring Rock Displacements Using GPS. He has conducted collaborative research with several countries. More than 350 of his scientific and technical papers have been published in international and domestic journals and conference proceedings. He has delivered about 45 keynote addresses and special lectures at international conferences, foreign universities, and research institutes.

The lecture will remain online so that those unable to attend at this time will be able to do it later. As usual, the attendees will be able to ask questions to the lecturer by e-mail during the subsequent five days. All online lectures are available from this page.

News
https://www.isrm.net

10th Nordic Grouting Symposium (NGS 2023) – registration open at 15 March 2023-03-08

The registration to the 10th Nordic Grouting Symposium, to be held from 11-13 September 2023, will open at 15 March.

41st ISRM Online Lecture by Professor Norikazu Shimizu is online 2023-03-23

The 41st ISRM online lecture by Professor Norikazu Shimizu is online at www.isrm.net. The lecture title is "Monitoring rock displacements using satellite technology".

15th ISRM International Congress & 72nd Geomechanics Colloquium 2023 - Registration open! 2023-03-24

The registration for the 15th ISRM InternationalCongress and 72nd Geomechanics Colloquium 2023 is now open!

Take advantage of the early booking until 30.06.2023!

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

NEWS - ITA ACTIVITIES
https://about.ita-aites.org/news

PUBLICATION OF THE 3RD EDITION OF "CODE OF PRACTICE FOR RISK MANAGEMENT OF TUNNEL WORKS" 22 March 2023

The 3rd edition of the Code of Practice for Risk Management in Tunnel Works has just been published!

This code of Practice is the latest edition of a Code prepared jointly by The International Tunnelling and Underground Space Association (ITA-AITES) and the International Association of Engineering Insurers (IMIA).

It aims at reducing the frequency and severity of serious incidents (resulting in insurance claims) to within sustainable boundaries.

This 3rd Edition follows an industry-wide survey that canvassed opinions on the application of the Code to date and any necessary updates.

The main areas of revision include adding a list of the principal attributes expected in the Code, addressing competence and culture, differentiating between risk management and management of risk, a new section on digital modelling, improved language on both instrumentation and monitoring and emergency response plans, and clarification of the importance of managing high consequence events.

Link: https://www.imia.com/

ITACET LUNCHTIME LECTURE SERIES #25 24 March 2023

Don't miss the 25th instalment of the Lunchtime Lecture Series organised in coordination with ITAtech.

This episode will focus on «Service of machinery in mechanized tunnelling». It will be run on Tuesday, April 11th and will begin at 13:00 CET time.

The session will feature three lectures and finish with a Q&A session with all speakers:

- TBM services: Before the launch - Marco Della Casa
- TBM services: After the launch - Doug Harding
- TBM services: Contractor's options from order to disassembly - Jens Classen

To sign up for free subscription: Lunchtime lecture series #25 | Itacet

1ST INTERNATIONAL SYMPOSIUM ON FIBER REINFORCED SHOTCRETE FOR UNDERGROUND MINING 31 March 2023

1st International Symposium on Fiber Reinforced Shotcrete for Underground Mining (InFum).

The InFum will bring together all sectors related to the underground mining industry and the research community to share knowledge and practical experience. The symposium will be held in the vibrant city of Rio de Janeiro, Brazil on October 1st to 3rd, 2023 at the campus of the Pontifical Catholic University of Rio de Janeiro (PUC-Rio).

Among the invited lecturers, some ITA-related people will participate like Tom Melbye, Alun Thomas and Tarcisio Celestino and also some other professors and researchers on the topic, like Marc Jolin (Laval University), Alberto de la Fuente (UPC, Barcelona), among others.

The programme includes the following topics:

- Rebound and placement of shotcrete for tunnel linings
- Use of steel fiber reinforced sprayed concrete in the final lining of conventionally excavated tunnels
- Computer controlled application of shotcrete: new trends on the mechanization of the industry
- Latest innovations on shotcrete admixtures to the mix fresh and hardened properties
- Durability development in sprayed concrete for rock support
- Advancements on the shotcrete nozzleing process
- On the methods for guaranteeing shotcrete placement quality control
- A general overview of the mechanical tests to design fiber reinforced shotcrete as ground support for underground mining works
- Application of the latest machine learning computational methods on the shotcrete lining properties evaluation

You can already register here: https://infum.com.br/registration/

Link: https://www.infum.com.br

Scooped by ITA-AITES #88, 23 March 2023

HS2 reveals design for last key structure for Chiltern Tunnel | UK

Double 15.01m Slurry TBMs victories in China

RFI kicks off tunnel excavation for Naples-Bari high-speed line in Italy

Right-line tunnel of Xiangya Road river-crossing passway drilled through in central China

First TBM launched for construction of Patna Metro underground section | India

Subterranean Japanese Libraries : underground library

Vancouver's Broadway Subway project celebrates second tunnel breakthrough | Canada

HAB wins Oslo E18 tunnel work | Norway

Car-free future: Europe's longest cycle tunnel aims to cut traffic in this Norwegian city

Tunnelling work for planned Bristol underground would be 'relatively easy' | UK

BRITISH TUNNELLING SOCIETY YOUNG MEMBERS

BTSYM Workshop In-Person
Tunnel waterproofing solutions: Current Trends and Future Innovations

Workshop Speaker: **Sarah Langley**

Thursday 23rd March 2023 at 15:30 to 17:30 hrs

BTSYM welcomes you to an in-person workshop with Sika, where waterproofing solutions applicable in Tunnelling will be demonstrated. The workshop will deliver a presentation covering Design Considerations in establishing the appropriate waterproofing approach, as well as specifying the right waterproofing solution. Furthermore, the attendees will have the opportunity to interact with the workshop leaders and perform a quick exercise taking into account construction considerations.

The evening promises to be a fantastic event and will comprise a series of case studies and innovations interspersed with a coffee / networking break.

Please find a rough agenda below:

- Waterproofing Materials & Solutions
- Networking break
- Future innovation in tunnel waterproofing
- Discussion & Close

Book your place at: BTSYM Registration Form

INTERNATIONAL GEOSYNTHETICS SOCIETY

News
www.geosyntheticssociety.org/news/page

IGS Releases First Sustainability Case Studies March 3, 2023

The IGS has published the first of a series of case studies showcasing the benefits geosynthetics can have on the environment. The profiles detail the … Read More »

'Green Construction' Featured At IGS Slovakia Conference March 7, 2023

Sustainable development using geosynthetics was among topics shared at IGS Slovakia's 14th national conference 'Geosynthetics 2023'. More than 80 experts from Slovakia and neighbouring countries … Read More »

The GeoAfrica 2023 Corporate Case Study Competition Winners March 12, 2023

During GeoAfrica2023 (20 -23 February 2023), in Cairo, Egypt, the International Geosynthetics Society (IGS) held its fourth and final regional Corporate Case Study competition, open … Read More »

The GeoAmericas "GeoJeopardy" Competition Seeks College Teams March 13, 2023

At GeoAmericas 2024 in Toronto (April 28 – May 1, 2024), a "GeoJeopardy" geotechnical trivia competition will be held. Questions will be centered around knowledge … Read More »

Did You Know?… Geosynthetics Protect The Environment From Plastic Waste March 14, 2023

An estimated 239 million metric tons of mismanaged plastic waste will enter the environment every year by 2040. Mismanaged plastic waste can be defined as … Read More »

Brisbane To Host GeoAsia8 March 15, 2023

Bask in the 'sunshine state' of Queensland when Brisbane, Australia, gets set to host the next Asian Regional Conference on Geosynthetics (GeoAsia) in 2025. The … Read More »

IGSF Annual Report 2022 Released March 20, 2023

The IGS Foundation (IGSF) is celebrating another dynamic year creating more opportunities for geosynthetics education worldwide. Its latest annual report tells of a busy 2022, … Read More »

Journal Special Issue On "Soil-Geosynthetic Interaction": Call For Papers March 21, 2023

A proposal for a special issue (SI) entitled "Soil-Geosynthetic Interaction" (including geosynthetic-geosynthetic interaction) is prepared for submission in the International Journal of Geosynthetics and Ground … Read More »

Quiz, Cruise And More For Young Members At GeoAfrica4 March 28, 2023

IGS Young Members cruised down the Nile and did battle in a geosynthetics quiz during the 4th African Regional Conference on Geosynthetics. The social events were … Read More »

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΤΕΧΝΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

Απονομή ICE Fellowship (FICE) στην Δρ. Αγγελική Γραμματικοπουλου

Congratulations to GCG's Senior Partner, Dr Angeliki Grammatikopoulou, for obtaining her ICE Fellowship (FICE) - the highest membership grade of the Institute of Civil Engineers - which recognises the significant contribution that Angeliki has made to society as a civil engineer.

Angeliki has more than 20 years' experience in academia and industry, specialising in soil characterisation, advanced constitutive modelling and numerical analysis of complex geotechnical problems, including foundations (onshore and offshore), retaining walls, deep excavations, tunnels and dams.

Angeliki is a real ambassador of the profession, and someone who can help shape the future of the ICE and industry.

To find out more about Dr Angeliki Grammatikopoulou, visit: https://lnkd.in/eNv3_vQD

(Geotechnical Consulting Group / LinkedIn, 17 March 2023)

Tina Marinatou finalist for the 2023 European Women In Construction & Engineering Awards & Rising Stars Ground Engineering Magazine Awards

Tina Marinatou, Geotechnical Engineer at Atkins, is a finalist for the 2023 European Women In Construction & Engineering Awards as Young Woman Engineer.

She is also shortlisted for the Rising Star category of the Ground Engineering Magazine Awards.

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

88th ICOLD Annual Meeting & Symposium on Sustainable Development of Dams and River Basins, April 2023, New Delhi, India, https://www.icold2020.org

Rocscience International Conference 2023 Synergy in Geotechnical Engineering, April 24-26, 2023, Toronto, Canada, www.rocscience.com/events/rocscience-international-conference-2023

UNSAT 2023 - 8th International Conference on Unsaturated Soils, 2-5 May 2023, Milos island, Greece, www.unsat2023.org

World Tunnel Congress 2023 Expanding Underground Knowledge & Passion to Make a Positive Impact on the World, 12 - 18 May 2023, Athens, Greece, https://wtc2023.gr

2nd International Workshop on Complex Formations, 9th May 2023, Torino, Italy, agi@associazionegeotecnica.it

NROCK2022 - The IV Nordic Symposium on Rock Mechanics and Rock Engineering, 24 – 26 May 2023, Reykjavic, Iceland, www.nrock2023.com

Underground Construction Prague 2023, May 29 – 31, 2023, Prague, Czech Republic, www.ucprague.com

UYAK 2023 5th International Underground Excavations Symposium and Exhibition Cities of the Future, Urban Tunnelling and Underground Excavations, 5-6-7 June 2023, Istanbul, Turkey, https://uyak.org.tr

17DECGE Danube – European Conference on Geotechnical Engineering, 7-9 June 2023, Bucharest, Romania, https://17decge.ro

SuperPile'23 Piling Design & Construction Conference, June 7-9, 2023, Atlanta, USA, www.dfi.org/superpile2023

3rd JTC1 Workshop on "Impact of global changes on landslide risk",7 – 10 June 2023, Oslo, Norway, https://jtc1-2023.com

RETC2023 Rapid Excavation and Tunneling Conference, June 11-14, 2023, Boston, USA, www.retc.org/index.cfm

ICOLD Annual Meeting 2023, 12th to 15th June 2023 Gothenburg, Sweden, https://icold-cigb2023.se

9th International Congress on Environmental Geotechnics Highlighting the role of Environmental Geotechnics in Addressing Global Grand Challenges, 25-28 June 2023, Chania, Crete island, Greece, www.iceg2022.org

DFHM8 TORINO 2023 8th International Conference on Debris Flow Hazard Mitigation, 26-29 June 2023, Torino, Italy, http://dfhm8.polito.it

NUMGE 2023 - Numerical Methods in Geotechnical Engineering 2023, 26 - 28 June 2023 Imperial College London, UK, www.imperial.ac.uk/numerical-methods-in-geotechnical-engineering

AFRICA 2023 - The Fourth International Conference and Exhibition on Water Storage and Hydropower Development for Africa, 10-12 July 2023, Lake Victoria, Uganda, www.hydropower-dams.com

Advances in Theory and Innovation in Practice
July 23-26, 2023, Arlington, Virginia, USA
www.geo-risk.org

In a time when artificial intelligence, big data, and machine learning are becoming more common in various disciplines of engineering, risk-based methods are attracting additional interest among practitioners and academicians through new textbooks, journals, dedicated sessions at G-I symposia and international activity.

Geo-Risk 2023: Advances in Theory and Innovation in Practice will showcase the latest interdisciplinary research and innovation in risk assessment and management to cater for the disruption in geotechnical practice and engage attendees on the broader vision and societal importance of geotechnical engineering in addressing risk and resilience issues of civil infrastructure.

Risk and probabilistic methods in geotechnical engineering are among the fastest growing areas in the profession. Geo-Risk 2023 will be the third specialty conference offered by the Risk Assessment and Management Committee of the ASCE Geo-Institute. Geo-Risk 2011, held in Atlanta, covered risk assessment and management in all fields of geoengineering while Geo-Risk 2017, held in Denver, featured "Geotechnical Risk: From Theory to Practice".

Special Topics for Geo-Risk 2023:

- Big Data, Artificial Intelligence, and Machine Learning in Geo-Engineering
- Reliability and Risk Assessment of Existing Geotechnical Infrastructure
- Risk and Reliability in Rock Engineering
- Advances on Probabilistic Methods for Resilient Geotechnical Infrastructure
- Risk-Based Approaches in Assessing Geohazards and Extreme Events
- Modeling Georisk in Construction
- Integrated Studies for De-Risking Projects: Geology, Geophysics, Geotechnical and Geomatics
- State-of-Practice in Modeling Spatial Variability
- Uncertainty Characterization of Geotechnical and Geological Models
- Best Practices of Risk Assessment and Management in Offshore Projects

- Advances in Reliability-Based Design and Risk- Based Code Development
- Practice of Risk Assessment and Management in Geo- Engineering
- Georisk in Climate Change, Sustainability, and Decarbonization
- Georisk in Engineering Education

Contact

Brad Keelor, Director
Lucy King, CMP, Senior Manager, G-I Conferences
American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191-4382

STPRFC 3rd Edition
Short-Term Prediction of Rock Failure Competition
August 2023, Taiyuan, China

Predicting and forecasting of major natural and engineering disasters in rock systems like earthquakes and landslides are a major problem, and Prof. Yangsheng Zhao, Academician of CAS, proposed and advocated STPRFC to promote the rapid solution of this problem. The innovative development of theories, methods, technologies and monitoring instruments to overcome this problem will surely be continuously motivated.

The content of STPRFC includes: the time of failure, the energy released by failure, and the location and type of failure. XPS-1000 servo-controlled rock mechanics test machine of TYUT was used in STPRFC. The loading mode was constant displacement rate loading, both granite and sandstone samples with size of 200×200×400 mm we-re tested.

The theories and methods used at 1st -and 2nd STPRFC include three categories: 1) AE, strain measurement, numerical simulation or machine learning algorithm; 2) Non-contact deformation measurement and AE; 3) displacement, thermal infrared imaging, and AE. There are obvious nonlinear softening and multi-peak stress point fluctuation characteristics, X-shaped, or X-shaped and vertical split fracture and the duration of failure varies from 3500 to 6000 s.

The competition requires 5-7 teams to develop the test methods and rock mechanics theory, and predict the instability and failure of rock specimens under the compression of a uniaxial text machine. The prediction results are compared according to the competition rules. In 2021, 14 universities and research institutes in China participated in the competition, and in 2022, 10 universities and research institutes in China participated in the competition. The main test methods used by the team include strain (displacement) measurement, wave velocity and acoustic emission measurement, thermal infrared imaging measurement, speckle displacement field measurement, etc. The adopted theories include neural network and other machine learning algorithms, finite element, discrete element, inverse analysis, etc. In the two competitions, the errors of the best prediction results are within 100 s in terms of rock failure time, and within the range of 0.8~0.9 in terms of the ratio of the best failure energy prediction value to the actual value.

In each of the previous STPRFC, the top three teams were awarded certificates.

Please download the flyer with more information.

Contact information

Lv Zhaoxing TEL: 13834540915, Email Box: alv-1001@163.com
Feng Zengchao TEL: 13191077109, Email Box: zc-feng@163.com

S3: Slopes, Support and Stabilization Conference, August 8-10, 2023, Boston, USA, www.dfi.org/s32023

17ARC 17th Asian Regional Geotechnical Engineering Conference, 14-18 August 2023, Nur-Sultan, Kazakhstan, https://17arc.org

ISMLG 2023 – 4th International Symposium on Machine Learning & Big Data in Geoscience, 29 August - 1 September 2023, University College Cork, Ireland, www.ismlg2023.com

IS-PORTO 2023 8th International Symposium on Deformation Characteristics of Geomaterials, 3rd - 6th September 2023, Porto, Portugal, www.fe.up.pt/is-porto2023

6th Meeting of EWG Dams and Earthquakes
Workshop on Case studies
September 5, 2023, Interlaken, Switzerland

A workshop on the sidelines of the 12th European Club Symposium in Interlaken, Switzerland is organized on Tuesday, September 5th from 15 :30 to 18 :30.

This meeting is dedicated to presentations centered on ***case studies of seismic analysis of dams***.

You are invited to send your intention to participate in the workshop and your possible wish to make a presentation.

Guillaume VEYLON, INRAe, guillaume.veylon@inrae.fr

12th ICOLD European Club Symposium "Role of dams and reservoirs in a successful energy transition", 5 to 8 September 2023, Interlakes, Switzerland, www.ecsymposium2023.ch

NGS 2023 10th Nordic Grouting Symposium, 11 - 13 September, 2023, Stockholm, Sweden www.ngs2023.se

SUT OSIG 9th International Conference "Innovative Geotechnologies for Energy Transition", 12-14 September 2023, London, UK, www.osig2023.com, www.sut.org

SAHC 2023 13th International Conference on Structural Analysis of Historical Constructions "Heritage conservation across boundaries", 12-15 September 2023, Kyoto, Japan, https://sahc2023.org/

XII ICG - 12th International Conference on Geosynthetics, September 17 – 21, 2023, Rome, Italy, www.12icg-roma.org

GROUND ENGINEERING SUSTAINABILITY, 21 September 2023, London, U.K., https://sustainability.geplus.co.uk/sustainability/en/page/home

Charles-Augustin COULOMB : A geotechnical tribute, 25 – 26 September 2023, Paris, France, www.cfms-sols.org/organisees-par-le-cfms/charles-augustin-coulomb-geotechnical-tribute

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

GEO AMERICAS 2023 5th Pan-American Conference on Geosynthetics Connecting State of the Art to State of Practice April 28 – May 1, 2024, Toronto, Canada, www.geoamericas2024.org

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

The Italian and International Associations of Earthquake Engineering are pleased to invite you to the 18th World Conference on Earthquake Engineering (WCEE2024) in Milan, Italy, from 30th June to 5th July 2024. This event is expected to attract more than 3000 participants, from academic/re-search institutions, industry and the public sector.

Technical Sessions

- AIM - Artificial Intelligence And Machine Learning
- ASR - Assessment And Retrofitting
- BCI - Bridges, Critical Facilities And Other Infrastructure
- CHH - Cultural Heritage And Historical Structures
- CMS - Concrete, Masonry, Steel, Timber Structures
- EVO - Evolution Of Earthquake Engineering And Seismic Codes
- EXP - Experimental Testing
- GEO - Geotechnical Earthquake Engineering And Site Response
- GRM - Ground Motions And Seismic Input
- IDD - Seismic Isolation And Energy Dissipation/Response Control Devices
- NSE - Non-Structural Elements
- REC - Post-Event Reconnaissance And Field Observations
- RES - Seismic Resilience Of Communities And Infrastructure
- SDM - Seismic Design And Modelling
- SHM - Structural Health Monitoring
- SHR - Seismic Hazard And Risk Assessment
- TNM - Tsunami, Natech, Multi-Hazard Risk Assessment

ORGANISING SECRETARIAT

AIM Group Italy – Milan Office
Via G. Ripamonti, 129 – 20141 Milan, Italy
Ph. +39 0256601.1
For general info: wcee2024@aimgroup.eu
For queries on submissions: wcee2024.sub@aimgroup.eu
For registration issues: wcee2024.reg@aimgroup.eu
For queries on sponsorship: wcee2024.sponsor@aimgroup.eu

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

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

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

2024 ISRM International Symposium
24-28 September, New Delhi, India

Contact Person Name

Dr. Mahendra Singh or Mr. A.K. Dinkar

Email sunil@cbip.org; secretary@cbip.org; msingh.civil@gmail.corn

Telephone +91 11 26115984 or +91 11 26116567

Address Plot No. 4, Institutional Are4 CBIP Building Malcha Marg, Chanakyapuri New Delhi - 110021 India

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

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

Contact Person Name

Henki Ødegaard

Email henki.oedegaard@multiconsult.no

Telephone +47 22 94 75 00

Address C/O Fredrik Stray, TEKNA, PO box 2312 Solli, Oslo, Norway

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

Organisers:

Austrian Geotechnical Society and Austrian Society for Geomechanics

Contact person: Prof. Helmut F. Schweiger

Email: helmut.schweiger@tugraz.at

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

Scope

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

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

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

Website http://eng.ksrm.or.kr/html/

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

The remarkable landslide in an olive grove near to Hatay, triggered by the Turkey-Syria earthquakes

Yesterday marked one month since the 6 February 2023 Turkey-Syria earthquakes, which have had such a devastating impact across a wide area of both countries. Investigations of the coseismic landslides continue – I recommend the Twitter account of the SLATE-landSLide Assessment TEam (@SLATE_landslide), a group of Turkish landslide specialists who are providing updates on their work investigating the major failures.

One landslide that has attracted some interest is the large failure in an olive grove near to Tepehan, which some people have termed the Hatay landslide. The location of the failure is [36.161, 36.222]. My friends at Planet have very kindly captured before and after satellite imagery of the failure using the high resolution SkySat instrument. This is the site before the landslide:-

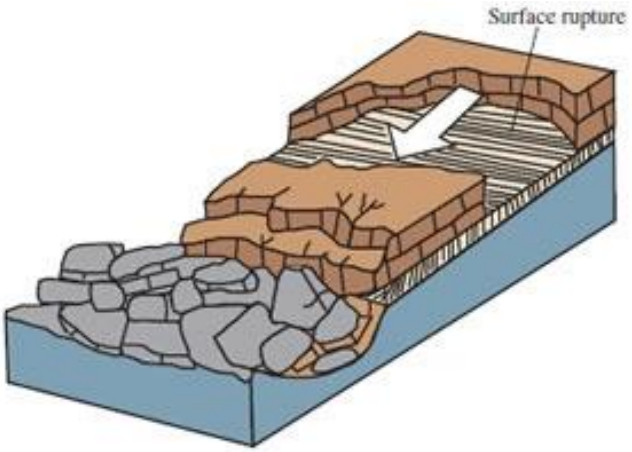
Satellite image of the site of the landslide in an olive grove near to Tepehan in Hatay, Turkey. Image copyright Planet, used with permission, collected on 21 November 2021.

Whilst this is the same site after the earthquake:-

Satellite image of the landslide in an olive grove near to Tepehan in Hatay, Turkey. Image copyright Planet, used with permission, collected on 22 February 2023.

I have created a slider that should allow you to compare the before and after images:-

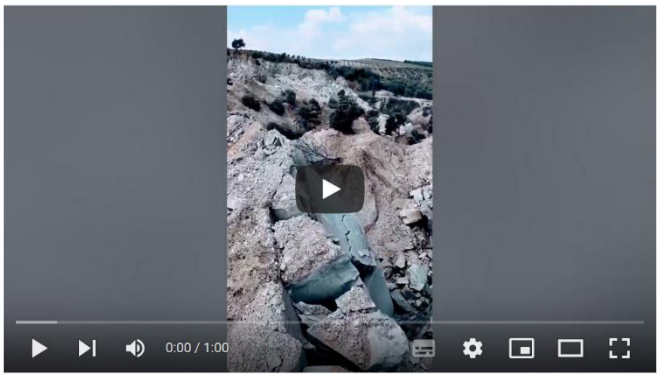
In the media there has been some confused reporting about this landslide, with some mistaking the landform for the fault rupture. This is a block slide type of failure, probably on a weak layer in a dip slope, which has allowed parts of the olive grove to remain intact despite large displacements. This block diagram from the USGS explains the concept well:-



USGS conceptual diagram of a block slide landslide.

Robin Lacassin has a good tweet that highlights the main features of the landslide close to Hatay:-

There is quite a nice video on Youtube showing the aftermath of the landslide:-



https://www.youtube.com/watch?v=cYquRC3nwEY

I will look forward to reading more about this failure once it has been investigated fully.

Acknowledgement and reference

Many thanks once again to the wonderful team at Planet.

Planet Team (2023). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA. https://www.planet.com/

(Dave Petley / THE LANDSLIDE BLOG, 7 March 2023, https://blogs.agu.org/landslideblog/2023/03/07/hatay-1)

Freight train derailed by rockslide in West Virginia, USA

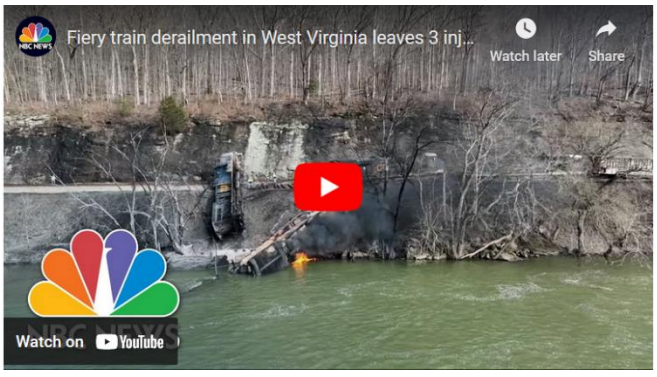
Train derailed in West Virginia (Jenny Harnish/AP)

A freight train was derailed due to a rockslide on Wednesday, March 8 at 4.51 a.m. near Sandstone, West Virginia.

More specifically, the train mainly consisted of empty coal cars and, according to USA today, nine of them derailed and caught on fire along with its four locomotives.

The accident resulted in, at least, one locomotive and one fuel tank falling into New River in addition to three crew members getting injured. As a result, diesel was spilled into the river.

It is worth mentioning at this point that New River is considered to be one of North America's oldest rivers and is part of the New River National Park and Preserve. Furthermore, according to the National Park Service, the river "has been in its present course for at least 65 million years" and part of it got diverted by glacial ice 10,000 years ago.



https://www.youtube.com/watch?v=WsqgJXUeMmc&t=1s

A plan has been deployed by the train company, in collaboration with the West Virginia Department of Environmental

Protection, for the diesel spill to be mitigated and remediated. This includes containing the leak and later removing contaminated soil and rocks from the site.

Finally, according to federal data from 2021 and 2022, there is an average of three derailments occurring in the U.S. per day. However, this number was about 6-7 times larger during 1979-1980.

(Geoengineer.org / Mar, 08, 2023, https://www.geoengineer.org/news/freight-train-derailed-by-rockslide-in-west-virginia-usa)

The 8 March 2023 rockslide and train derailment in Sandstone, West Virginia

On 8 March 2023 a rockslide triggered the derailment of a coal train near to Sandstone in West Virginia, USA. AP has an article that describes the event, which includes this image of the aftermath:-

The aftermath of the 8 March 2023 rockslide and train derailment near to Sandstone in West Virginia. Image from Jenny Harnish/The Register-Herald via AP.

The rockslide that triggered the derailment was small, as the image above shows. However, it was sufficient to derail all four locomotives and nine coal cars, according to a statement by the train operator, CSX. The front locomotive, which was transporting three members of the train crew, caught fire. All three people escaped, although they were injured.

The track has now been cleared and has reopened.

The image above shows the fresh scar from the small landslide that triggered the derailment. It is very interesting to note the devastating effect that such a comparatively minor failure can inflict. As I have highlighted previously, landslides and trains are a challenging combination.

Acknowledgement

Many thanks to Matthew Eynon for bringing this one to my attention.

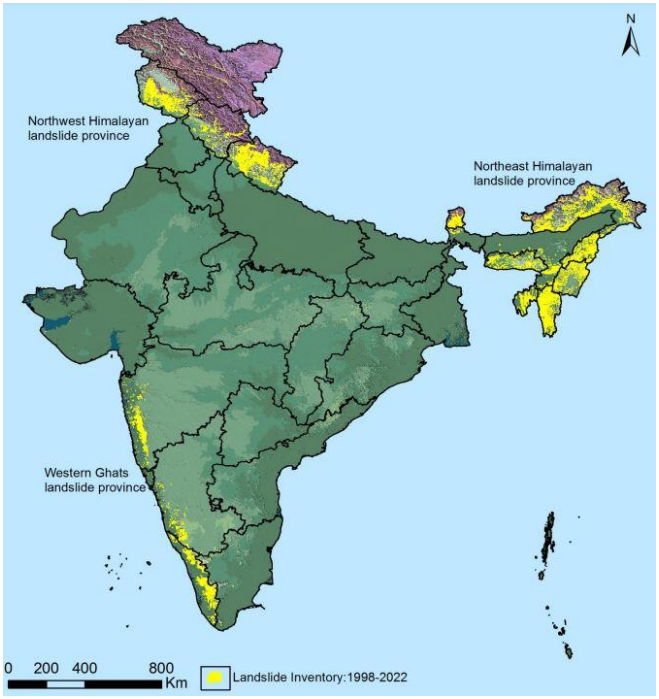
(Dave Petley / THE LANDSLIDE BLOG, 17 March 2023, https://blogs.agu.org/landslideblog/2023/03/17/sandstone-derailment-1)

The NRSC/ISRO Landslide Atlas of India

The National Remote Sensing Centre (NRSC) of the Indian Space Research Organisation (ISRO) released last week a Landslide Atlas of India, which is freely available online. It provides maps of about 80,000 landslides that have been identified across India in the period between 1998 and 2022, with a particular emphasis on seasonal landslides triggered by the 2014 and 2017 monsoon seasons, as well as by the Sikkim earthquake.

The Atlas has been compiled using imagery collected from a range of sensors, including the Indian satellites IRS-1D PAN+LISS-III, Resourcesat-1, 2 & 2A LISS-IV Mx, Cartosat-1 and 2S; and international instruments such as Sentinel-1&2, Pleiades and WorldView; and through the use of aerial photographs.

One of the key results is a single map showing all of the identified landslides in India:-



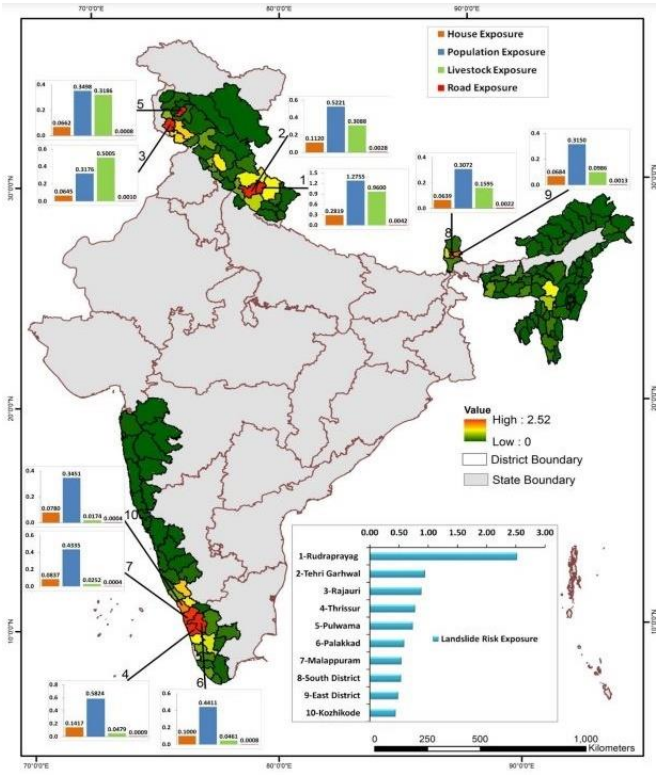
A map showing all of the identified landslides in India. Source: NRSC/ISRO Landslide Atlas of India,

This is fascinating map, highlighting the ways in which landslides are geographically concentrated, particularly in the northern (mountainous) areas and along the southwest margin of the country.

The atlas also provides a very interesting assessment of macro-level socioeconomic risk exposure to landslides:-

The bar chart then indicates the ten districts with the highest socioeconomic risk exposure to landslides, of which Rudraprayag and Tehri Garhwal in Uttaranchal rank highest. This assessment feels quite experimental to me, but it is interesting. I would be fascinated to hear more details about it as the description in the atlas is quite brief.

This atlas is a really interesting initiative to highlight landslide risk in one of the most impacted countries globally. Intriguingly, the Economic Times has just published a separate article about landslide impacts in Himachal Pradesh, which is one of the high landslide impact states in the north of the country. The analysis has been undertaken by the Himachal Pradesh State Disaster Management Authority (although the report does not appear on their website).



Socioeconomic risk exposure to landslides in India, based on the NRSC/ISRO Landslide Atlas of India.

The study has identified 17,120 landslide prone sites across Himachal Pradesh. Of these, 675 have been identified as posing higher levels of risk, and the report indicates an increasing trend with time (although I must caveat that simply comparing two years of data, as the report seems to do, is not indicative of a valid trend). Perhaps most interestingly, the Economic Times reports that:

"High intensity rainfall coupled with cutting of hill slopes or rocks at the foothills are the main reason behind the significant number of landslides, experts say. Extensive cutting of hill slopes for construction and widening of roads, blasting for tunnels, hydro projects and mining are cited as reasons behind the increase in landslides, geological expert Prof Virender Singh Dhar said."

The point that poor construction and land management practices are the key factors behind the increasing landslide impacts in India is well made.

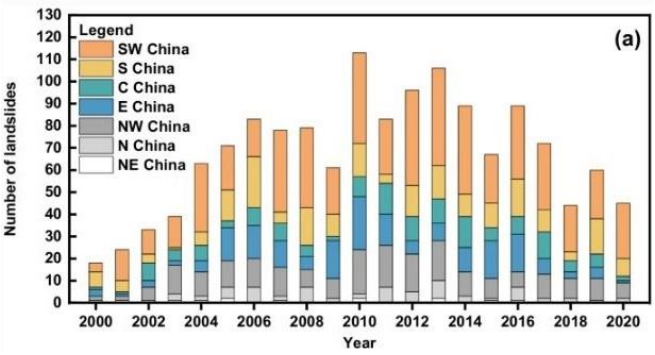
(Dave Petley / THE LANDSLIDE BLOG, 13 March 2023, https://blogs.agu.org/landslideblog/2023/03/13/atlas)

The relationship between GDP and fatal anthropogenic landslides in China

One of the interesting observations Melanie Froude and I noted in our work on global fatal landslides (Froude and Petley 2018) was that the long term trend in China was surprising. In the early period of our work we saw a steady increase in the number of fatal landslides in China, but in the latter part of the study period we saw a decline. We were unsure as to how we could interpret this, in part because we did not know whether it was a real signal (reporting in China is controlled, so we thought it could be that the data was inconsistent).

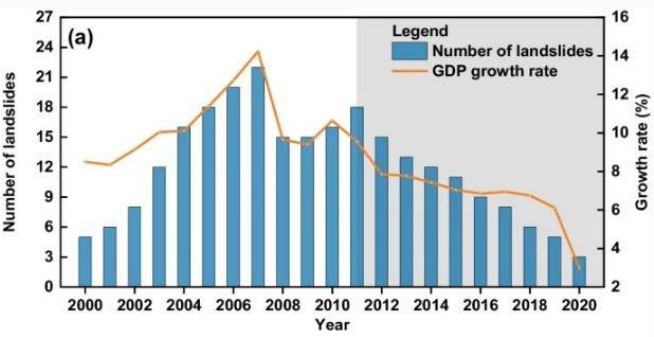
A new study (Zhang *et al.* 2023) has compiled and analysed a dedicated fatal landslide database for China, which is really welcome. The research team is based in Zhejiang University, so the dataset is much more likely to be reliable. The study period was 1940 to 2020, although clearly the data quality for the early years of this period is inconsistent. As a result, there is a more detailed analysis of the period from 2000 to 2020.

Interestingly, like us the authors noted that fatal landslide occurrence is declining in China. Indeed, in their data there was a steady upward trend from 2000 to 2010, and a downward trend thereafter. This is the annual total, broken down by geographical region:-



The annual total number of fatal landslides in China, broken down by geographical region. from Zhang et al. (2023).

Understanding the cause of this change is extremely important. Zhang *et al.* (2023) have looked at this in some detail. One element is potentially explained in the graph below, from the paper, which shows the number of fatal anthropogenic landslides with time:-



The annual pattern of anthropogenic landslides and the growth of GDP with time in China. Graph from Zhang et al. (2023).

Here the peak is a little earlier (around 2007), and again the declining trend in the latter years is very clear. So, it appears that at least a part of the trend observed in China is due to a reduction in the number of anthropogenic landslides. But this is when it gets really interesting. The orange line on the graph is the growth in GDP for China. The similarity in trend between the number of fatal landslides and the GDP is remarkable (Zhang *et al.* 2023 have calculated the correla-tion coefficient to be 0.832).They explain this as follows:-

The years of rapid GDP growth were usually accompanied by a large number of human activities. These activities modified

natural slopes through construction, mining, and quarries, among others, which greatly increased the risks of landslides.

So, it appears that in years of very rapid GDP growth, poorly controlled activities on slopes led to an increased number of fatal landslides. As GDP growth has slowed, the number of fatal anthropogenic landslides has also reduced.

I'm amazed by the strength of the correlation – it appears that GDP growth rate in effect switches fatal landslides on and off.

The authors are absolutely right to present the analysis, and their explanation, and this is an excellent piece of work. I'm left wondering though whether this relationship is real or one of those strange statistical artefacts that sometimes emerge. Can the cause and effect really be as strong as this? And does this apply elsewhere?

It's a fascinating result that deserves further attention.

References

Froude, M. J. and Petley, D. N. 2018. Global fatal landslide occurrence from 2004 to 2016. *Natural Hazards and Earth System Sciences*, **18**, 2161-2181, https://doi.org/10.5194/nhess-18-2161-2018.

Zhang, S., Li, C., Peng, J. *et al.* 2023. Fatal landslides in China from 1940 to 2020: occurrences and vulnerabilities. *Landslides* (2023). https://doi.org/10.1007/s10346-023-02034-6

(Dave Petley / THE LANDSLIDE BLOG, 16 March 2023, https://blogs.agu.org/landslideblog/2023/03/16/gdp-china)

61st Rankine Lecture: 'Simplify your models as much as possible'

In the 61st Rankine Lecture, John Carter presented his interpretation of developments in the field of constitutive modelling and emphasised the importance of understanding the capabilities and limitations of models used in advanced numerical analysis.

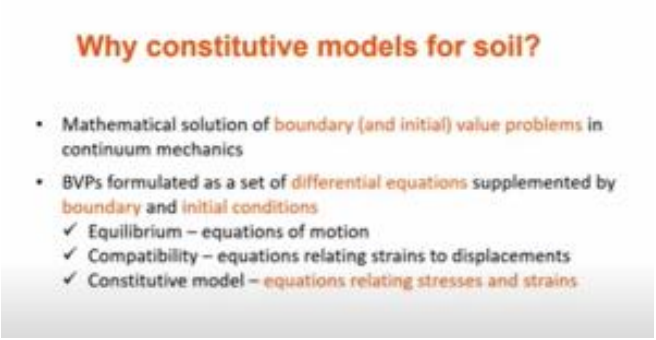
For the topic of the 61st Rankine Lecture, University of Newcastle, Australia emeritus professor and geotechnical engineer John Carter chose to return to an area of theoretical geomechanics to which he had been attracted since the beginning of his academic career.

He presented the lecture, titled "Constitutive modelling in computational geomechanics", at Imperial College London on Wednesday (15 March) evening.

"I'm talking about modelling the response of geomaterials to various forms of perturbations, specifically stress-strain or constitutive modelling. And today, what I want to do is address the mechanical response of various types of soils and review the progress that we've made on this topic over more than half a century," he explained at the start of his presentation.

"My major aims in this presentation are twofold. Firstly, I'd like to present my own interpretation of what's happened of significance in this field over the last 50 years or so. And secondly, I hope to convince you, if convincing is indeed necessary, of the importance of understanding the capabilities, and especially the limitations, of the models we use in our advanced numerical analysis these days. Many of the models that I will mention are now available in commercial software. So, I think it's incumbent on those using that software, and even those directing its use, to understand how such models behave."

What are constitutive models for soil and why develop them?



"They are mathematical relationships between stresses and strains," Carter explained.

"In computational geomechanics, we generally seek mathematical solutions to what are known as boundary value problems or initial value problems. And very often in doing so, we would represent our soil body as a continuum. And it's useful to remind ourselves that these boundary value problems are usually formulated as a set of differential equations which might be subjected to particular conditions. These equations would set out in mathematical detail the three conditions of equilibrium compatibility, and the constitutive relationships that have to be obeyed."

In his lecture, Carter focused on classical elastoplastic models, which is a subset of the approaches suggested for modelling geomaterials.

Carter began the lecture by saying that modelling now forms an important aspect of geotechnical engineering, and that the kind of model that needs to be adopted and its degree of sophistication are dependent on the questions being asked.

"But we should always remember that models are merely imperfect idealisations of reality," he stressed.

A message that Carter believes is crucial to keep in mind was succinctly stated by British statistician George Box when he wrote "all models are wrong, but some are useful".

"And essentially they're all wrong because they're only ever approximations and no amount of elaboration will ever make them absolutely correct," Carter continued.

As factors that complicate the constitutive modelling of soil, he listed:

- **The non-linear relation between stress and strain: hardening and softening; and dilation/volume change coupled with shearing**
- **Behaviour of natural soils in situ is not the same as reconstituted laboratory samples due to structure and fabric, as well as anisotropy**
- **Rate effects, for example, strain rate dependence and creep**
- **Non-monotonic loading, for example, cyclic loading**
- **Parameter determination.**

To wrap up his lecture, Carter noted that some of his concluding comments "may seem obvious, even banal, if you will".

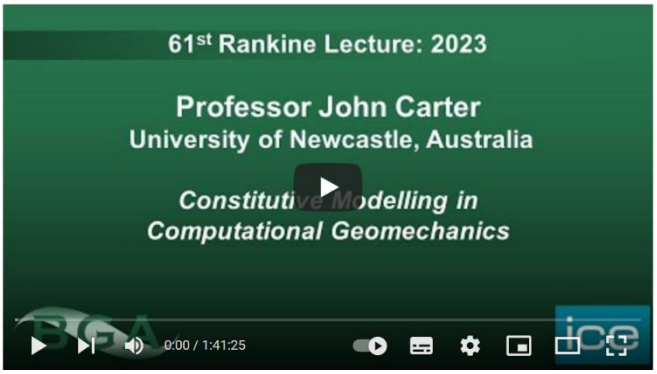
"But I do think it's important for us to recognise and celebrate what's been achieved over the years and what still limits the reliable use of numerical packages the employ constitutive models," he said.

"We have come a long way in 50 years and you've got these advanced models now available in commercial packages. The trick is to use them correctly."

Over the last five decades, a number of journals, papers and textbooks have been devoted to this topic.

He continued: "I also should repeat that the perfect models have not been invented and probably never will be.

"And may I end with a simple plea, I think it's incumbent on those who undertake numerical modelling and who, frankly, are brave enough to try and predict the future, to simplify their models as much as possible. And, in this regard, knowing what to ignore is really a key skill."



https://www.youtube.com/watch?v=0DGS3yp3vFI

(Nia Kajastie / GROUND ENGINEERING, 17 March, 2023, https://www.geplus.co.uk/news/61st-rankine-lecture-simplify-your-models-as-much-as-possible-17-03-2023)

Chaido (Yuli) Doulala-Rigby

I think my favourite quote from John's Rankine Lecture, and one I live by and always advice students and early careers professionals to follow is: 'False knowledge is more dangerous than ignorance!' So basically know your knowledge boundaries and be professional to say 'I don't know', no matter if you are a graduate engineer, the chief engineer or technical director, we are only humans after all!

62nd Rankine lecturer announced as Lidija Zdravkovic

The British Geotechnical Association (BGA) has announced that the 62nd Rankine Lecture will be delivered by Imperial College London professor of computational geomechanics Lidija Zdravkovic.

Lidija Zdravkovic is also head of the geotechnics section in the department of civil and environmental engineering at Imperial College London.

She has 30 years' experience in research, teaching and consulting in geotechnical engineering. She has authored around 250 technical papers, which span her research inter-ests in the development and application of numerical meth-ods in geotechnical engineering and in the experimental char-acterisation of diverse soil behaviour.

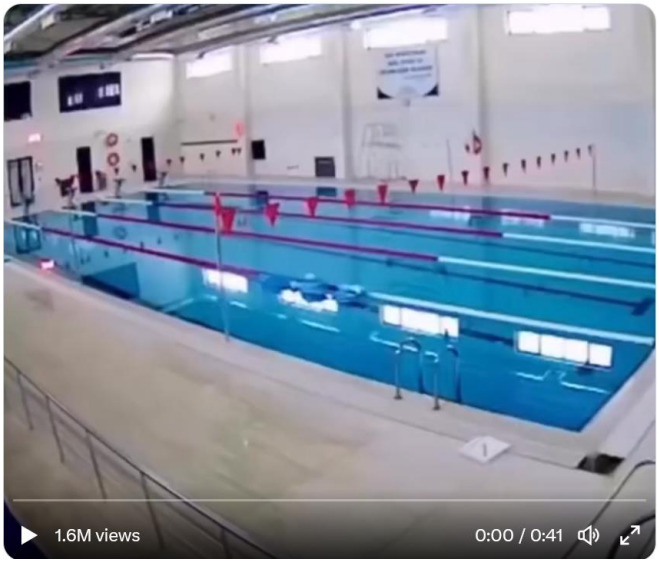
In her response to the invitation to give the lecture, Zdravkovic said: "I feel very privileged to have been selected by the British Geotechnical Association to deliver the 62nd Rankine Lecture.

"The lecture will likely include my research interests of integrating advanced numerical methods and ground charac-terisation to address contemporary geotechnical engineering challenges of energy security, decarbonisation and climate change."

The lecture will be held at Imperial College London in March 2024.

(Thames Menteth / GROUND ENGINEERING, 16 March, 2023, https://www.geplus.co.uk/news/62nd-rankine-lecturer-announced-as-lidija-zdravkovic-16-03-2023)

This is a pool during the earthquake in Turkey



19.Mar.2023, https://twitter.com/historyinmemes/status/1637563352149905408

How engineers at Silvertown Tunnel are using 'nitrogen skates' for a record-breaking TBM rotation

Engineers working on the Silvertown Tunnel have successfully rotated the first 1,400t section of the UK's largest tunnel boring machine (TBM) 180° in the reception chamber using an innovative "nitrogen skate" system.

The Silvertown Tunnel is a new twin-bore road tunnel currently under construction beneath the River Thames between Silvertown and Greenwich. It is being delivered by Riverlinx CJV, a joint venture of Bam Nuttall, Ferrovial and SK Ecoplant, for Transport for London.

On 15 February the TBM broke through at Greenwich, on the south side of the river, having completed the 1.1km drive for the southbound tunnel.

Most twin-bore tunnels either use two TBMs or dismantle the single TBM and return it to the initial launch point for its second drive. The site, time and financial constraints on the Silvertown Tunnel project meant that the team decided to devise a way to rotate the machine 180° and send it back under the river to bore the northbound 1.1km tunnel.

"This was the most efficient way of doing the two tunnels from a cost perspective and a programme perspective," Riverlinx operations director Borja Trashorras said. "And in doing so, we've done it in the most innovative way that we could, in a way which has never been done before in the UK."

TBMs have been rotated in a similar manner in Paris and Stuttgart, Trashorras explained, but in both cases it was just to make the extraction of the machines easier – not to bore another tunnel.

It has also never been done with a machine this large. The Silvertown Tunnel TBM is 82m long from cutter head to the end of its backup gantries and the cutter head has a 12m diameter. The tunnelling shield alone is 19m long from cutter head to the rear of the screw conveyor and weighs 1,400t.

A rotation chamber was excavated at the point where the TBM breaks through from its southbound drive at Greenwich. The chamber is 18m deep from base slab to surface, 40m long from headwall to rear wall and 39m wide. The TBM will emerge into the chamber in four sections - the shield and the three backup gantries.

The shield was brought into the chamber first and onto a platform-like restraint system, which allowed it to maintain ring pressure at 40bar so that it could continue installing the cement rings even as it was emerging. When the shield had fully emerged from the tunnel, it was separated from the adjoining gantry.

The TBM broke into the rotation chamber at a 4% gradient, rising from from the flat base of the tunnel beneath the river to the surface. The first stage in rotating it was to make sure it was level.

The first step to levelling the shield was moving the cutter head slightly out from the rest of the shield. "It's very delicate this machine in terms of its centre of gravity," explained Riverlinx project manager Ivor Thomas. As the cutter shield was edging its way out of the tunnel, a special hydraulic system for levelling it was put in place beneath it. A large steel band was put in place to catch the rear of the TBM shield as it emerged. The hydraulic rams were directly beneath this band and were then used to jack up the rear of the shield level with the front.

The cradle holding the TBM head, sitting atop the hydraulic jacks and nitrogen skate system

The next step saw a special steel cradle "floated" under the TBM shield on nitrogen skates, which are stationed all around the underside of the cradle. The nitrogen skates are a system of hydraulic feet sitting atop a layer of compressed nitrogen, which allows the cradle holding the machine to "skate" across the surface.

"Machines have been rotated on compressed air before, but to rotate a machine of this size on compressed air we'd probably have needed to hire all of the compressors in the UK," Thomas said. "We used nitrogen because it's commonly available, it's inert, it's not poisonous, it's lighter than air – and you get a lot of bang for your buck. We were able to use a bank of 12 bottles of nitrogen for this system."

The top of the system features stainless-steel hydraulic oil jacks at 350bar, which can be jacked up and down to do the fine levelling of the machine and ensure it's truly horizontal. Below this are the skates, wide and flat circular feet with a rubber skirt, which have nitrogen pumped in through hoses and maintained at 250bar. When the cradle is ready to be moved, the hydraulic system is locked off and the skates move on a bubble of nitrogen. The floor of the rotation chamber is covered in a layer of 20mm thick steel plates that are

grouted into position and then oiled to ease the movement of the skates.

Engineers tending to the cradle, sitting on the nitrogen skate system

"We're not lifting it; the nitrogen system is about breaking down the friction between the steel plate and the machine," Thomas explained. "There is a skirt around the bottom of each skate and we pump in very small amounts of nitrogen. We oil the steel plates and break down the friction, allowing us to move 1,400t of machine."

The movement is achieved by pulling it with remote controlled 25t air winches that are anchored to the walls of the rotation chamber. The shield was pulled away from the tunnel portal, then pulled sideways to make two "handbrake turns", before being aligned with the tunnel eye for the second bore. "It's like a big hovercraft," Thomas said. The rotation and movement from one side of the chamber to the other took a day.

The cradle attached to the 25t air winch, atop the nitrogen skate system

The same process will be repeated with the first gantry in April. The gantry is lighter than the shield head, but longer. "In terms of space, gantry one is probably the most difficult to do," Trashorras said. "But in terms of key principles, the rotation is exactly the same; we'll put the cradle underneath it and pull it with the pulley system that's anchored to the wall."

Once rotated, the first gantry will be reattached to the cutter shield and the TBM will commence what is known as the umbilical launch, which should start by the end of April. The part-TBM will start on the second bore, reaching around 70m into the drive. Meanwhile, the second and third gantries will be brought into the chamber, rotated and attached. Once the full length of the TBM is reconnected, the digging can enter "full mode". It is hoped that this can be achieved by the end of June.

With the TBM completely out of the southbound tunnel, the spoil conveyor can be put in place. This belt will take spoil from the TBM back down the northbound tunnel, do a U-turn in the rotation chamber and take the it back through the southbound tunnel to Silvertown. From there, it will be removed from site via barge.

The rotation of the TBM for the Silvertown Tunnel is likely to become a pathfinder process for other projects necessitating a twin bore, Trashorras said. "Other clients are now considering this as a potential for future projects where they're trying to do it as efficiently as possible and trying to meet other agendas such as cost, carbon footprint or reduced materials," he said. "I can't disclose which clients, but people are very keen to understand whether this was a success and whether it can be showcased anywhere else in the UK."

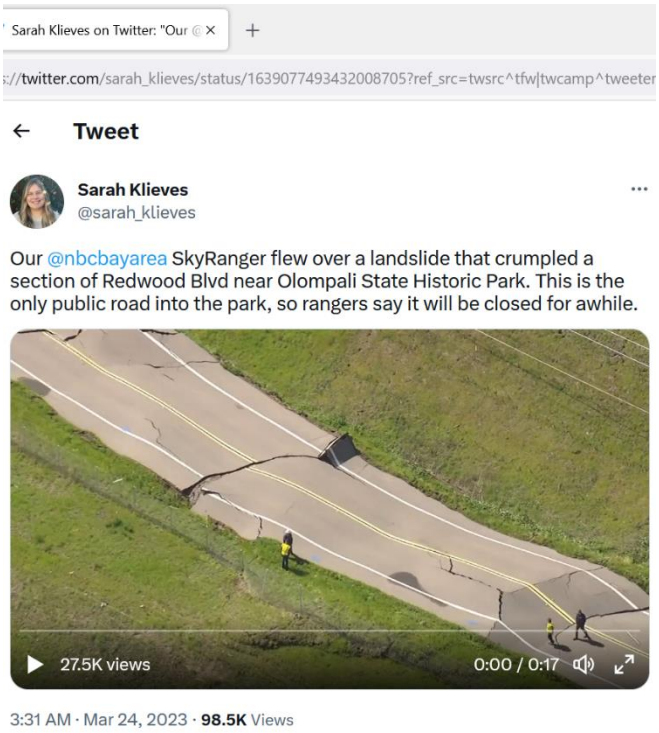
(Rob Hakimian / NEW CIVIL ENGINEER, 23 Mar, 2023, https://www.newcivilengineer.com/latest/how-engineers-at-silvertown-tunnel-are-using-nitrogen-skates-for-a-record-breaking-tbm-rotation-23-03-2023)

Novato: an interesting landslide triggered by heavy rainfall in California

Last week, the latest in a long series of large storms struck California, triggering another round of flooding and landslides. One particularly interesting slope failure occurred at Novato in Marin County. The San Francisco Chronicle has a nice image of the aftermath:-

The aftermath of the landslide in Novato, California. Image from the San Francisco Chronicle.

A Tweet by Sarah Klieves, a senior producer for NBC Bay Area, provides the best perspective though:-



https://twitter.com/sarah_klieves/status/1639077493432008705

This is a view from that video, showing the landslide:-

The landslide at Novato, California. Image from a Tweet by Sarah Klieves of NBC Bay Area.

The location of the landslide appears to be [38.1444, -122.5652]:-

Google Earth image of the site of the landslide at Novato, California.

Interestingly, Redwood Boulevard, which is the road damaged by the landslide, was constructed in 2015. A Google Earth image from March that year shows that the slope at the site of the landslide was cut and reprofiled, and that drains were installed:-

Google Earth image of the site of the landslide at Novato, California in March 2015, showing engineering works underway at the site.

It is interesting that at this site the slope is a little steeper than in the adjacent areas, which presumably is the reason for the additional works, including the drains. That failure is a classic slump. Fortunately the toe has not extended to the main highway, and the limited mobility of the debris has meant that this road is unaffected. However, the landslide has caused disruption to a watermain and to a gas pipeline.

(Dave Petley / THE LANDSLIDE BLOG, 27 March 2023, https://blogs.agu.org/landslideblog/2023/03/27/novato-1)

Deadly landslide hits Alausí, Ecuador, destroying homes and part of Pan-American Highway

At least 16 people were killed and 7 are missing after a landslide hit Ecuador's mountain village of Alausí.

On Sunday, March 26, 2023, a tragic landslide occurred in the mountain village of Alausi in Ecuador's Chimborazo province, resulting in 16 fatalities, 7 missing persons, and 16 injuries. The village, situated in the Andes mountain range, is approximately 220 km (137 miles) south of the nation's capital, Quito.

The catastrophe caused significant damage, including the destruction of a section of the Pan-American Highway.

Emergency response teams, including firefighters, police, and specialized rescue personnel, have been working to locate and save those trapped under the debris. To date, six individuals have been found alive, while the search for at least seven missing persons continues. The landslide has affected around 500 people in total.

https://twitter.com/canarvaezm/status/1640328603198971907

A local resident recounted the terrifying landslide, stating that the mountainside came crashing down "like a rocket" on Sunday evening, engulfing multiple homes in earth and rock.

Heavy rainfall in the region led to the formation of fault lines,

as reported by local media. These warnings were evident when the highway connecting Alausí and Guamote was indefinitely shut down due to cracks in the tarmac.

To prevent further casualties, Ivan Vinueza, the governor of Chimborazo, ordered evacuations in the affected area, as new landslides are a potential risk.

President Guillermo Lasso had previously declared a state of emergency in 14 provinces that were experiencing extreme weather conditions.

The Andean nation has been grappling with the consequences of heavy rainfall since the start of the year, with a death toll of 22 people.

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

https://www.youtube.com/watch?v=Xh2LdI-6kic

Update:

11:03 UTC, March 28

On March 27, officials reported 16 deaths, but President Guillermo Lasso put the confirmed toll at 7 as he arrived at the scene of the disaster in Alausí late Monday.

The reports mention more than 30 rescued people and 23 hospitalized.

Around 163 homes and 1 school have been damaged or destroyed.

Water and power infrastructure were also impacted.

Residents living in about 600 homes in the area, considered to be at risk, have been ordered to evacuate.

07:47 UTC, March 30

On March 29, authorities reported 12 fatalities, 67 missing, 31 injured and 32 rescued people. In addition, 500 people have been affected as well as more than 160 houses.

References:

[1] Ecuador landslide: More than a dozen killed in Alausí – BBC – March 27, 2023

[2] Landslide in central Ecuador kills at least 16 people – AP – March 27, 2023

[3] Ecuador landslide kills at least 16, others reported missing – Al Jazeera – March 27, 2023

(THE WATCHERS, Monday, March 27, 2023 Updated on-Thursday, March 30, 2023, https://watchers.news/2023/03/27/deadly-landslide-hits-alausi-ecuador-destroying-homes-and-part-of-pan-american-highway/)

The coin celebrates long and rich history of tunnelling in Austria

It is so great when your hobby and profession have something common. One of my hobbies is coin collecting. Each coin has a story, and coins which I want to tell you about, commemorate tunnels. I want to start with my favourite and unique one 25 Euro coin issued in 2013.

The coin celebrates long and rich history of tunnelling in Austria.

"Opened in 1854, the vertex tunnel of the Semmering railway was the world's first alpine tunnel. The 'New Austrian Tunnelling Method', which uses stress of surrounding rock to strengthen a tunnel, was developed from 1957 to 1965 and has since done a great deal to revolutionize tunnel construction around the world. A present-day tunnel boring machine features in the niobium pill of the coin's obverse, its rotating motion symbolized by three arrows. The obverse's outer silver ring shows the mountains through which the machine pierces. The coins reverse makes excellent use of the niobium pill to show one of the many road tunnels that pepper Austria's alpine landscape today, while a tunnel worker uses a pneumatic drill to loosen rock in the silver ring alongside the word "Tunnelbau" (tunnel construction)".

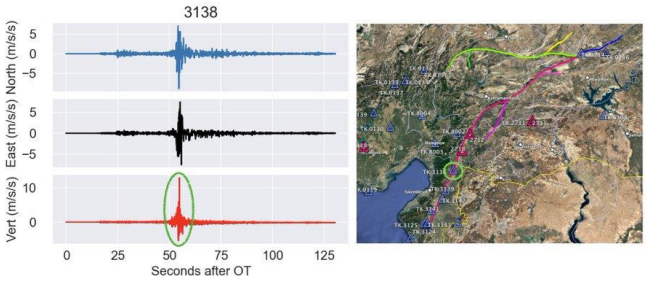
Dmitry Kiselev

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ & ΑΝΤΙΣΕΙΣΜΙΚΗ ΜΗΧΑΝΙΚΗ

~120%g of acceleration in the vertical

Just noticed station TK.3138, only 800 m from the M7.8 rupture. It has ~120%g of acceleration in the vertical! That's unheard of I think. This would mean that, for a moment, you would be, not weightless, but being flung up in the air at ~20%g. If real this is an amazing record.

Lots of questions from folks. This is a seismogram from the mag 7.8 event recorded at the station in the green circle on the right. The faults that moved are the colored lines. The wiggles show the shaking was extremely high, anything over 2 m/s/s is considered "very strong" 1/n

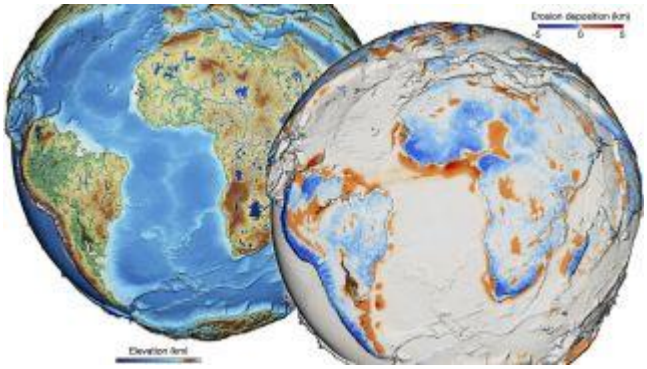


(Prof. Diego Melgar, @geosmx, Mar 18, https://twitter.com/geosmx/status/1637195129500082176)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Watch 'unprecedented' animation showcasing 100 million years of Earth history

A new model shows how the planet's surface evolved over the past 100 million years, from the shifting of tectonic plates to the movement of sediments.



Stills showing Earth's elevation and erosion rates from a new model of 100 million years of geological history. (Image credit: Tristan Salles, University of Sydney)

New "unprecedented" animations of the Earth show how the planet's surface has shifted and changed over the past 100 million years.

These animations are the most detailed view of the history of Earth's topography ever, depicting the rise of mountains, the development of basins, and the transport of large masses of sediments around the globe through erosion.

The animations show the movements of tectonic plates, the large rafts of crust that bump up against each other to form mountain ranges and pull apart to form ocean basins. When these plates dive into the mantle, or Earth's middle layer, at subduction zones they give rise to planet-shaping volcanoes and earthquakes. But there are other forces shaping the surface, too: Precipitation erodes away the surface, while the rate of weathering alters levels of carbon dioxide in the air, creating a feedback loop that links the land to the atmosphere.

"While the dance of the continents has been studied extensively, we are still limited in our understanding and representation of how the Earth's surface has evolved," said Tristan Salles, a senior lecturer in geosciences at the University of Sydney and the lead author of a new paper describing the model, which was published March 2 in the journal Science.

"What we bring with this new model," Salles wrote in an email to Live Science, "is a way to evaluate how this surface has changed (globally and over geological time scales) shaped by its interactions with the atmosphere, the hydrosphere, the tectonic and mantle dynamics."

The model begins 100 million years ago in the midst of the breakup of the supercontinent Pangaea, which started to occur around 200 million years ago. In the beginning of the animation, the continents that will become Africa and South America are already recognizable, with the Northern Hemisphere continents coming together tens of millions of years later. Blue shows the flow of water, while red shows the intensity of the deposition of new sediments by erosion.

"This unprecedented high-resolution model of Earth's recent past will equip geoscientists with a more complete and dynamic understanding of the Earth's surface," study co-author Laurent Husson, a geologist at the Institute of Earth Sciences (ISTerre) in Grenoble, France, said in a statement.

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

Putting together all of these different pressures on the evolution of Earth, from the movements of the plates to the flow of water to the slow changes in the mantle, provides a new way to ask questions about everything from the regulation of the climate to the ways the circulation of the atmosphere affect erosion on land.

The researchers found that the rate of sediment movement across the globe was likely much larger than what scientists believe based on observation, probably because the sedimentary record is fragmented. Overall erosion rates have been fairly steady for the past 100 million years, Salles said, but there have been changes in whether the sediment ends up trapped in low-elevation basins on land or ultimately flows out to sea. For example, there was a doubling of sediment flow to the oceans between about 60 million and 30 million years ago, which was likely associated with the rise of the Himalaya Mountains and the Tibetan Plateau, the researchers wrote.

Such nuances could be important, Salles said. For example, some of the earliest life formed in shallow marine environments, where microorganisms harnessed photosynthesis for the first time and left behind mineralized formations known as stromatolites.

"It is thought that sedimentation flux may have provided a source of nutrients to these early organisms, allowing them to thrive and evolve over time," Salles said. "We envision that our model could be used to test such long-standing hypotheses regarding the origin of life on Earth."

(Stephanie Pappas / LIVE SCIENCE, 16 March 2023, https://www.livescience.com/watch-unprecedented-animation-showcasing-100-million-years-of-earth-history)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

Ανακάλυψη για Νόμπελ που μπορεί να αλλάξει τον κόσμο: Ένζυμο βακτηρίου μετατρέπει τον αέρα σε ηλεκτρική ενέργεια

Image by Jukka Niittymaa from Pixabay

Μια ανακάλυψη που εκτός από υποψηφιότητα για βραβείο Νόμπελ μπορεί να αλλάξει και τον κόσμο έκαναν επιστήμονες στην Αυστραλία.

Ένα ένζυμο βακτηρίου μετατρέπει τον αέρα σε ηλεκτρική ενέργεια. Το ένζυμο είναι μία «φυσική μπαταρία» που χρησιμοποιεί τις μικρές ποσότητες υδρογόνου στην ατμόσφαιρα για να δημιουργήσει ηλεκτρικό ρεύμα. Ανοίγει έτσι, πιθανώς, ο δρόμος για την παραγωγή μίας νέας μορφής ανανεώσιμης ενέργειας φιλικής στο περιβάλλον.

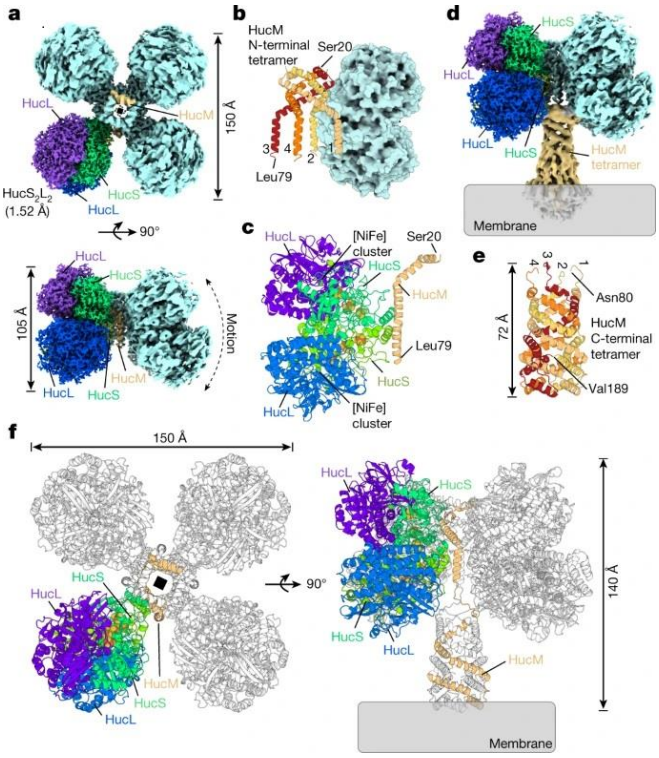
Οι ερευνητές του Πανεπιστημίου Μόνας της Μελβούρνης, με επικεφαλής τον καθηγητή Κρις Γκρίνιγκ, οι οποίοι έκαναν τη σχετική δημοσίευση στο περιοδικό «Nature», ανέφεραν ότι αρκετά βακτήρια χρησιμοποιούν το υδρογόνο του αέρα ως ενεργειακή πηγή που τους βοηθά να αναπτύσσονται. Τώρα, για πρώτη φορά μελέτησαν εξονυχιστικά ένα μη παθογόνο κοινό βακτήριο του εδάφους, το Mycobacterium smegmatis, και βρήκαν ένα ένζυμό του, το Huc, που είναι ικανό να «τρώει» υδρογόνο και να παράγει ρεύμα.

Όπως σημείωσε ο ερευνητής δρ Ρις Γκρίντερ, «το Huc είναι εντυπωσιακά αποτελεσματικό. Αντίθετα με όλα τα άλλα γνωστά ένζυμα και χημικούς καταλύτες, καταναλώνει υδρογόνο σε πολύ χαμηλά ατμοσφαιρικά επίπεδα, μόλις το 0,00005% του αέρα που αναπνέουμε».

Η έρευνα έδειξε ότι το Huc είναι δυνατό να αποθηκευθεί για μακρά χρονική περίοδο. «Είναι εντυπωσιακά σταθερό. Είναι δυνατό αυτό το ένζυμο να καταψυχθεί ή να θερμανθεί στους 80 βαθμούς Κελσίου, κρατώντας πάντα τη δύναμη να παράγει ενέργεια. Αυτό αντανακλά την ικανότητα του ενζύμου να βοηθά τα βακτήρια να επιβιώνουν στα πιο ακραία περιβάλλοντα, από την Ανταρκτική μέχρι τους κρατήρες ηφαιστείων και τα βάθη των ωκεανών», τόνισαν οι ερευνητές.

Η ανακάλυψη του Huc, αν και η έρευνα βρίσκεται ακόμη σε αρχικό στάδιο, ανοίγει τον δρόμο για την ανάπτυξη συσκευών παραγωγής ενέργειας από τον αέρα αντί από τον ήλιο ή τον άνεμο. Υπάρχουν, άλλωστε, και άλλα βακτήρια που διαθέτουν ένζυμα παρόμοια με το Huc.

«Φανταζόμαστε ότι μία ενεργειακή πηγή που θα περιέχει Huc θα μπορεί να τροφοδοτεί με ρεύμα μία γκάμα μικρών φορητών συσκευών που θα χρησιμοποιούν τον αέρα, όπως βιομετρικών αισθητήρων, συστημάτων παρακολούθησης του περι-βάλλοντος, ψηφιακών ρολογιών, μικρών υπολογιστών κ.ά. Όμως, όταν το Huc τροφοδοτείται με περισσότερο υδρογόνο, παράγει και περισσότερο ηλεκτρικό ρεύμα. Αυτό σημαίνει ότι θα μπορούσε να αξιοποιηθεί σε κυψέλες καυσίμων για να τρο-φοδοτεί με ενέργεια πιο πολύπλοκες συσκευές, όπως έξυπνα ρολόγια, έξυπνα κινητά τηλέφωνα, φορητούς υπολογιστές ή πιθανώς ακόμη και αυτοκίνητα», δήλωσε ο Γκρίντερ.



Συνεπώς, το επόμενο σημαντικό βήμα θα είναι η δυνατότητα παραγωγής του εν λόγω ενζύμου σε μεγάλες ποσότητες, έτσι ώστε μελλοντικά να μπορεί να αξιοποιηθεί για τη μαζική παραγωγή καθαρής ενέργειας.

(Hellas Journal, 09/03/2023, https://hellasjournal.com/2023/03/anakalipsi-gia-nompel-pou-bori-na-allaxi-ton-kosmo-enzimo-vaktiriou-metatrepi-ton-aera-se-ilektriki-energia)

Structural basis for bacterial energy extraction from atmospheric hydrogen

Rhys Grinter, Ashleigh Kropp, Hari Venugopal, Moritz Senger, Jack Badley, Princess R. Cabotaje, Ruyu Jia, Zehui Duan, Ping Huang, Sven T. Stripp, Christopher K. Barlow, Matthew Belousoff, Hannah S. Shafaat, Gregory M. Cook, Ralf B. Schittenhelm, Kylie A. Vincent, Syma Khalid, Gustav Berggren & Chris Greening

Abstract

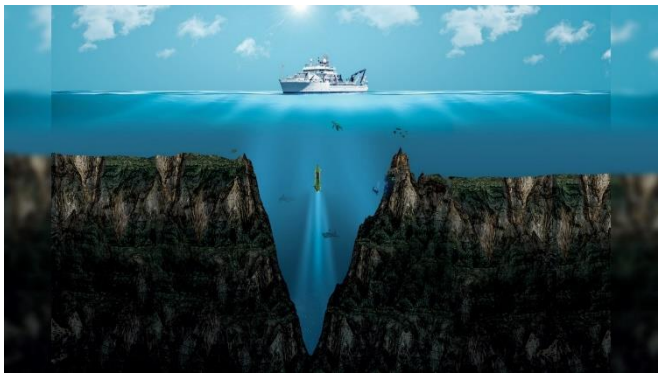
Diverse aerobic bacteria use atmospheric H_2 as an energy source for growth and survival[1]. This globally significant process regulates the composition of the atmosphere, enhances soil biodiversity and drives primary production in extreme environments[2,3]. Atmospheric H_2 oxidation is attributed to uncharacterized members of the [NiFe] hydrogenase superfamily[4,5]. However, it remains unresolved how these enzymes

overcome the extraordinary catalytic challenge of oxidizing picomolar levels of H_2 amid ambient levels of the catalytic poison O_2 and how the derived electrons are transferred to the respiratory chain[1]. Here we determined the cryo-electron microscopy structure of the *Mycobacterium smegmatis* hydrogenase Huc and investigated its mechanism. Huc is a highly efficient oxygen-insensitive enzyme that couples oxidation of atmospheric H_2 to the hydrogenation of the respiratory electron carrier menaquinone. Huc uses narrow hydrophobic gas channels to selectively bind atmospheric H_2 at the expense of O_2, and 3 [3Fe–4S] clusters modulate the properties of the enzyme so that atmospheric H_2 oxidation is energetically feasible. The Huc catalytic subunits form an octameric 833 kDa complex around a membrane-associated stalk, which transports and reduces menaquinone 94 Å from the membrane. These findings provide a mechanistic basis for the biogeochemically and ecologically important process of atmospheric H_2 oxidation, uncover a mode of energy coupling dependent on long-range quinone transport, and pave the way for the development of catalysts that oxidize H_2 in ambient air.

Nature (2023), March 2023, https://www.nature.com/articles/s41586-023-05781-7

How deep is the Mariana Trench?

The bottom of the Mariana Trench is about 35,876 feet (10,935 meters) deep, making it deeper than Mount Everest is tall.



An illustration of Mariana Trench, the deepest point on Earth. (Image credit: DOERS)

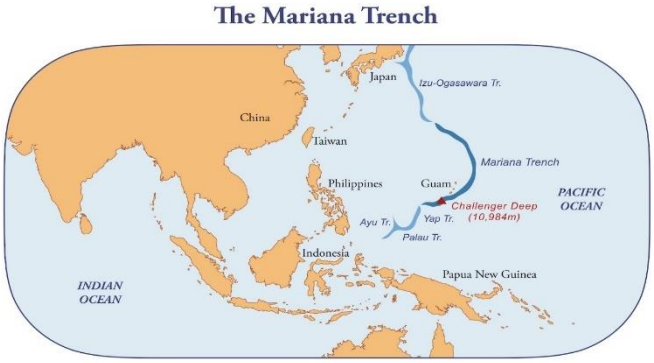
The deepest depths of the sea are found in the crescent-shaped Mariana Trench, located in the western Pacific Ocean. But what is the deepest point of the Mariana Trench?

The Mariana Trench is about 1,580 miles (2,550 kilometers) long and located to the east of the Mariana Islands, which give the trench its name, according to the University of Washington (opens in new tab). The deepest spot in the Mariana Trench is a valley called the Challenger Deep, located at the Mariana Trench's southern end, according to the National Oceanic and Atmospheric Administration (opens in new tab) (NOAA).

According to NOAA, the Challenger Deep extends about 35,876 feet (10,935 meters) below the surface. That makes it about 7,000 feet (2,100 m) deeper than Mount Everest is tall, NOAA noted (opens in new tab).

NOAA's estimate comes from a 2021 study in the journal Deep Sea Research Part I: Oceanographic Research Papers (opens in new tab), based on data from a 2020 voyage. However, there are many other estimates of the depths of the Challenger Deep. The first crewed mission there, in 1960, returned an estimate of 35,797 feet (10,911 m), according to Guinness World Records (opens in new tab). Since then, recent estimates have included 36,069 feet (opens in new tab) (10,994 m) and 36,036 feet (10,984 m (opens in new tab)).

Why is estimating the depth of the Challenger Deep so challenging? "Fundamentally, it is difficult because it is so deep," Cmdr. Sam Greenaway of the NOAA Corps and lead author of the 2021 study, told Live Science.



A map of the Mariana Trench in the Pacific Ocean. Its deepest part, Challenger Deep, is highlighted in red. (Image credit: Dimitrios Karamitros)

To measure ocean depths using modern instruments, scientists basically have two options: sonar mounted on a ship on the ocean's surface, or a pressure sensor deployed on the seabed that can help gauge how much water lies above it, Greenaway said.

Sonar beams from multibeam echo sounders "can produce complete coverage of the seabed," said Greenaway, the marine operations lead on NOAA's new ship construction team. "As good as they are, the ship systems are really far from the seabed, which limits both the horizontal and vertical accuracy of the measurement."

For instance, with the Challenger Deep, "it takes sound about 14 seconds to go down to the seabed and back," and the salinity, temperature and pressure of the water can affect the speed and path the sound takes, Greenaway said. As a result, the vertical accuracy of an echo-sounder measurement is about 80 feet (25 m), he noted.

With a pressure sensor, building a pressure gauge that is accurate enough at such high pressures is quite challenging, Greenaway said. On the floor of the Challenger Deep, the pressure is more than 1,000 times the standard atmospheric pressure at sea level, Guinness World Records noted.

"After that, we need to correct for the density of the water above the sensor, the gravity pulling that water down, the pressure of the atmosphere, and tides," Greenaway noted. "Deploying a pressure sensor to the right place is a bit of a trick too."

To make their measurements, Greenaway and his colleagues dropped a pressure sensor on the seafloor to serve as a benchmark for their echo-sounder readings. "The uncertainty of the pressure sensor dominated our overall uncertainty, but instrument manufacturers are making great progress on improving these sensors, so I expect this component of the uncertainty might improve substantially in the future," he said.

The surfaces of both Mars and the moon are mapped to a greater resolution and accuracy than the bottom of the ocean is, Greenaway said in a Reddit post (opens in new tab). "I have spent most of my career working with various aspects of seafloor mapping," he told Live Science. "I think it is surprising to many people just how much of that mapping work remains to be done."

In practical terms, "the difference of the Challenger Deep being 10,935 meters deep, as we determined, or 10,984 meters, as a recent mapping campaign estimated, doesn't really matter that much," Greenaway said. "However, the idea that we need to go out and measure the depth of the world's oceans is really important." For instance, such research can help with the precise positioning of underwater vehicles, as well as with pressure sensors that help monitor water-level fluctuations due to climate change, he said.

The depth is also important to deep-sea explorers. On March 26, 2012, filmmaker James Cameron dove 35,787 feet (10,908 m) in the Deepsea Challenger submersible vessel into the oceanic trench, setting the record for the deepest solo dive. In 2019, explorer and businessman Victor Vescovo made the deepest dive on record, at 35,853 feet (10,927 m) into the Pacific Ocean. Vescovo worked with deep-sea specialists, including Capt. Don Walsh, an oceanographer with the U.S. Navy who is known for diving with Swiss oceanographer and engineer Jacques Piccard to the Challenger Deep on Jan. 23, 1960. They became the first people to reach the deepest part of the ocean, at about 35,814 feet (10,916 m).

(Charles Q. Choi / LIVESCIENCE, 11.03.2023, https://www.livescience.com/how-deep-is-the-mariana-trench)

Scientists create 'cosmic concrete'

Scientists have developed a new material made from extra-terrestrial dust and potato starch which has the potential to become a greener alternative to common concrete. "StarCrete" can be made in any ordinary oven or microwave and is twice as strong as ordinary concrete, according to researchers at the University of Manchester. It was created while searching for ways in which astronauts could make buildings on Mars. Since astronaut food contains starch, the scientists experimented with potato starch as a binding agent for Martian dust they simulated. Common salt, which can be obtained from the planet's surface "or from the tears of astronauts", improves the material's strength even more.

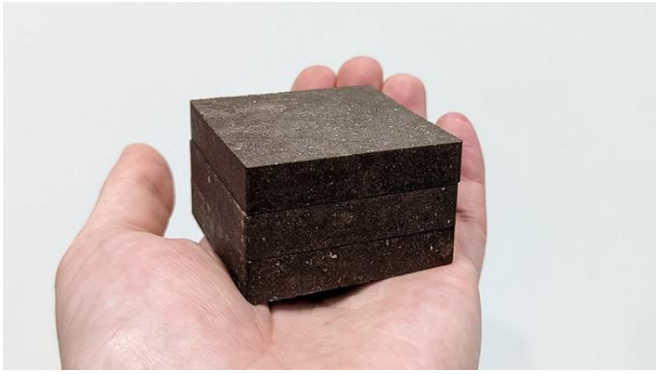
- The scientists founded a start-up to explore how "StarCrete" could be used on Earth.

- Cement and concrete, which require high firing temperatures and large amounts of energy to produce, account for about 8% of global CO2 emissions.

(Katarina Lukač, Editor at LinkedIn News , 25/03/2023, https://www.linkedin.com/news/story/scientists-create-cosmic-concrete-6206306)

Potato starch and Martian soil make 'cosmic concrete' for extra-terrestrial structures – just add astronaut tears

Simulated Martian soil, potato starch and salt have been combined into a new concrete-like material that could one day be used to build structures on Mars.



The tough new material, known as StarCrete, was developed by a team of researchers at the University of Manchester.

Using terrestrial materials to build infrastructure in space would be "prohibitively expensive and difficult to achieve" with current methods, the researchers said. Instead, future space construction will need to rely on simple materials that are easily available to astronauts.

StarCrete offers a possible solution, the researchers claimed. The material is reportedly twice as strong as ordinary concrete, and could be perfectly suited for construction work in extra-terrestrial environments.

The team used ordinary potato starch as a binder, mixed with simulated Mars dust to create StarCrete. Testing showed that the material has a compressive strength of 72 Megapascals (MPa), over twice as strong as the 32 MPa of ordinary concrete. StarCrete made from Moon dust was even stronger, at over 91 MPa.

This work improved on a previous project from the same team, which theorised that astronaut blood and urine could be used as a binding agent. While the resulting material had a compressive strength of around 40 MPa, the process had the drawback of requiring blood on a regular basis. When operating in an environment as hostile as space, this option was seen as less feasible than using potato starch.

"Since we will be producing starch as food for astronauts, it made sense to look at that as a binding agent rather than human blood," said lead researcher Dr Aled Roberts, research fellow at the Future Biomanufacturing Research Hub.

"Also, current building technologies still need many years of development and require considerable energy and additional heavy processing equipment, which all adds cost and complexity to a mission. StarCrete doesn't need any of this and so it simplifies the mission and makes it cheaper and more feasible.

"And anyway, astronauts probably don't want to be living in houses made from scabs and urine!"

Either way, the future astronauts might have to make some sacrifices to build their extra-terrestrial homes – the researchers discovered that magnesium chloride, a common salt found in tears, "significantly improved" the material's strength. Thankfully, it should also be obtainable from the Martian surface.

The researchers calculated that a 25kg sack of dehydrated potatoes contains enough starch to produce almost half a

tonne of StarCrete, equivalent to 213 bricks – a three-bedroom house takes roughly 7,500 bricks to build.

Dr Roberts and his team recently launched a start-up company, DeakinBio, which is exploring ways to improve StarCrete so it can also be used in a terrestrial setting.

If used on Earth, StarCrete could offer a greener alternative to traditional concrete, the researchers claimed. Cement and concrete account for about 8% of global carbon dioxide emissions, as the process by which they are made requires very high firing temperatures. StarCrete can be made in an ordinary oven or microwave at normal home baking temperatures, reducing the amount of energy required.

The work was published in the journal *Open Engineering*.

(PROFESSIONAL ENGINEERING, https://www.profeng.com/2023/03/16/potato-starch-and-martian-soil-make-cosmic-concrete-for-extra-terrestrial-structures-just-add-astronaut-tears-2/content.html)

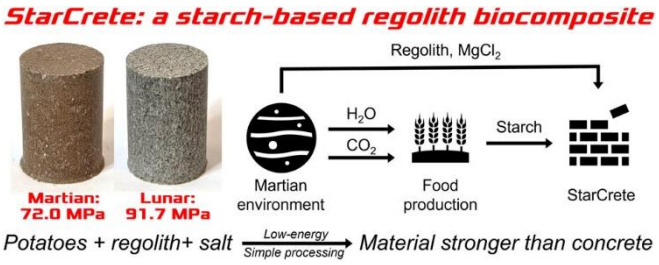
StarCrete: A starch-based biocomposite for off-world construction

Aled D. Roberts and Nigel S. Scrutton

Abstract

Robust and affordable technology capabilities are needed before a sustained human presence on the lunar and Martian surfaces can be established. A key challenge is the production of high-strength structural materials from *in situ* resources to provide spacious habitats with adequate radiation shielding. Ideally, the production of such materials will be achieved through relatively simple, low-energy processes that support other critical systems. Here, we demonstrate the use of ordinary starch as a binder for simulated extraterrestrial regolith to produce a high-strength biocomposite material, termed StarCrete. With this technique, surplus starch produced as food for inhabitants could be used for construction, integrating two critical systems and significantly simplifying the architecture needed to sustain early extraterrestrial colonies. After optimisation, lunar and Martian StarCrete achieved compressive strengths of 91.7 and 72.0 MPa, respectively, which is well within the domain of high-strength concrete (>42 MPa) and surpasses most other proposed technology solutions despite being a relatively low-energy process. The flexural strength of the lunar and Martian StarCrete, at 2.1 and 8.4 MPa, respectively, was also comparable to ordinary concrete (2.5–4.5 MPa).

Graphical abstract



Keywords: starch; biocomposite; in situ resource utilisation; space; biopolymer–bound soil composites; design of experiments

Open Engineering, https://doi.org/10.1515/eng-2022-0390, https://www.degruyter.com/document/doi/10.1515/eng-2022-0390/html

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

https://isrm.net/newsletter/show/240

Κυκλοφόρησε το Τεύχος Αρ. 61 του ISRM Newsletter - Μαρτίου 2023 με τα ακόλουθα περιεχόμενα:

- 15th International ISRM Congress, Salzburg, Austria - registration is open!
- 41st ISRM Online Lecture by Prof. Norikazu Shimizu
- Volume 25 - 2022 of the ISRM News Journal is online
- A quick report on the M7.8 and M7.6 Pazarcik and Ekinözü earthquakes in Türkiye, on 6 February 2023
- Short-Term Prediction of Rock Failure Competitions held in Taiyuan, China
- ISRM Rocha Medal 2025 nominations
- NROCK2023 - The IV Nordic Symposium on Rock Mechanics and Rock Engineering
- 3rd JTC1 Workshop on Impact of Global Changes on Landslide Hazard and Risk
- NGS 2023 - the 10th Nordic Grouting Symposium
- 1st Chilean Congress on Rock Mechanics
- 1st SLRMES Conference on Rock Mechanics for Infrastructure and Geo-Resources Development
- ISRM Sponsored Conferences

Κυκλοφόρησε το IGS Newsletter της International Geosynthetics Society με τα ακόλουθα περιεχόμενα:

IGS NEWSLETTER – March 2023

Helping the world understand the appropriate value and use of geosynthetics

www.geosyntheticssociety.org/newsletters

- 'Impactful' GeoAfrica4 Puts Sustainability Center Stage READ MORE
- GeoAfrica 2023 Corporate Case Study Competition Winners READ MORE
- GeoAfrica 2023 Proceedings Available ACCESS HERE
- Registration Open for 12th ICG! REGISTER HERE
- GeoAmericas 2024 Call for Abstracts SUBMIT AN ABSTRACT
- The GeoAmericas "GeoJeopardy" Competition Seeks College Teams APPLY HERE
- Sustainability Focus
  IGS Releases First Sustainability Case Studies READ MORE
  Did You Know?... Geosynthetics Protect The Environment From Plastic Waste READ MORE
- Proceedings Available From XXXII Italian National Geosynthetics Conference PURCHASE HERE
- Calendar of Events

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2019 – 2023)

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

ΕΕΕΕΓΜ

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

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

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

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