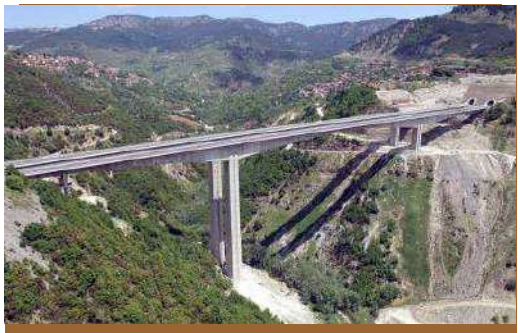

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20 Χρόνια «Αθηναϊκή Διάλεξη Γεωτεχνικής Μηχανικής»

Ο θεσμός της Αθηναϊκής Διάλεξης Γεωτεχνικής Μηχανικής της Ελληνικής Επιστημονικής Εταιρείας Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ΕΕΕΕΓΜ) συμπληρώνει εφέτος 20 χρόνια. Προηγούμενοι ομιλητές υπήρξαν ορισμένοι από τους πιο διακεκριμένους γεωτεχνικούς μηχανικούς στην Ελλάδα και παγκοσμίως. Οι ομιλητές που έχουν δώσει την Αθηναϊκή διάλεξη μέχρι σήμερα είναι οι:

1η: Harry Poulos τον Ιανουάριο 2000
«Piled Raft Foundations – Design and Applications»

2η: Robert Mair τον Ιανουάριο 2002
«Tunneling – induced ground movements and their effects on structures»

3η: Γιώργος Γκαζέτας τον Φεβρουάριο 2004
«Αλληλεπίδραση Εδάφους-Θεμελίου-Κατασκευής υπό Συνθήκες Εδαφικής Αστοχίας και Μεγάλων Παραμορφώσεων: Νέα Πρότυπα Εμπνευσμένα από τον Σεισμό της Νικομήδειας 1999»

4η: Alain Pecker τον Ιανουάριο 2006
«Enhanced seismic design of shallow foundations-example of the Rion - Antirrion bridge»

5η: Ανδρέας Αναγνωστόπουλος τον Μάρτιο 2008
«Καθιζήσεις επιφανειακών θεμελιώσεων»

6η: John Burland τον Ιανουάριο 2010
«Interaction between geotechnical and structural engineers»

7η: Στέφανος Τσότσος τον Φεβρουάριο 2012
«Διαχείριση της αβεβαιότητας στη Γεωτεχνική Μηχανική – Ο ρόλος της Ενόργανης Παρακολούθησης και των Μετρήσεων»

8η: Nick Barton τον Φεβρουάριο 2014
«Lessons learnt from Q and from tunnel and cavern design and performance»

9η: Σπύρος Παπασπύρου τον Μάρτιο 2015
«Ωθήσεις Γαιών και Τεχνολογία Κατασκευής Αγκυρίων στον Ελληνικό Χώρο»

10η: Σπύρος Καβουνίδης τον Μάρτιο 2016
«Κατολισθήσεις στην Ελλάδα. Εδαφομηχανική στην πράξη»

11η: Δημήτρης Κούμουλος τον Μάρτιο 2017
«Γεωτεχνική Αποθέσεων Απορριμμάτων»

12η: Lidija Zdravkovic τον Ιανουάριο 2019
«Assessing the geotechnical risk associated with natural and cut slopes»

και για το 2020 στις 7 Απριλίου θα δοθεί η 13η Αθηναϊκή Διάλεξη από τον Ομότιμο Καθηγητή ΑΠΘ και Πρόεδρο της Ευρωπαϊκής Ένωσης Σεισμικής Μηχανικής (ΕΑΕΕ) Κυριαζή Πιτιλάκη με θέμα «Επιρροή των εδαφικών συνθηκών στα σεισμικά φορτία σχεδιασμού και την σεισμική διακινδύνευση σε κλίμακα τεχνικού έργου, πόλης και χώρας».

Έχει πλέον αποφασιστεί ότι από την προσεχή διάλεξη, όλες οι Αθηναϊκές Διαλέξεις θα βιντεοσκοπούνται για αρχειακούς λόγους, ενώ το σχετικό αρχείο με την μαγνητοσκοπημένη διάλεξη θα αναρτάται και στην υπό ανακατασκευή ιστοσελίδα της ΕΕΕΕΓΜ.

ΕΛΛΗΝΙΚΗ
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ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

Αθήνα, 6 Μαρτίου 2020

ΠΡΟΣΚΛΗΣΗ

Η Ελληνική Επιστημονική Εταιρεία Εδαφομηχανικής και Γεωτεχνικής Μηχανικής (ΕΕΕΕΓΜ) έχει την τιμή να σας προσκαλέσει στην

13η Αθηναϊκή Διάλεξη Γεωτεχνικής Μηχανικής

η οποία θα δοθεί από τον **Κυριαζή Πιτιλάκη**, Ομότιμο Καθηγητή ΑΠΘ με θέμα

Επιρροή των εδαφικών συνθηκών στα σεισμικά φορτία σχεδιασμού και την σεισμική διακινδύνευση σε κλίμακα τεχνικού έργου, πόλης και χώρας

Η διάλεξη θα δοθεί στην Αίθουσα Τελετών του Κτιρίου Διοίκησης του Εθνικού Μετσοβίου Πολυτεχνείου στην Πολυτεχνειούπολη Ζωγράφου την Τετάρτη **7 Απριλίου 2020, ώρα 18:30** (προσέλευση από 18:00)

Ο Πρόεδρος
Δρ Μ. ΜΠΑΡΔΑΝΗΣ

Ο Γραμματέας
Δρ Γ. ΜΠΕΛΟΚΑΣ

Λόγω κορωνοϊού η διάλεξη αναβάλλεται.

Περίληψη
13ης Αθηναϊκής Διάλεξης Γεωτεχνικής Μηχανικής

Στο πλαίσιο της αναμόρφωσης του EC8 και της ανάπτυξης του Ευρωπαϊκού μοντέλου σεισμικής επικινδυνότητας και σεισμικής διακινδύνευσης (ESRM20), εξετάζονται καταρχήν οι σύγχρονες εξελίξεις στην επιρροή του εδάφους στην σεισμική απόκριση εδαφικών σχηματισμών και στα σεισμικά φορτία σχεδιασμού τεχνικών έργων. Ακολούθως παρουσιάζεται μια νέα πρόταση εδαφικής κατηγοριοποίησης και εκτίμησης συντελεστών εδαφικής ενίσχυσης που εξαρτώνται από την ένταση του σεισμικού κραδασμού. Στην συνέχεια παρουσιάζονται εν συντομία οι εξελίξεις στην εκτίμηση της τρωτότητας κτιρίων και τεχνικών έργων με βάση τις ερευνητικές εργασίες του Εργαστηρίου Εδαφοδυναμικής και Γεωτεχνικής Σεισμικής Μηχανικής του ΑΠΘ. Η σύνθεση των προηγουμένων καταλήγει στην συνοπτική παρουσίαση του προτεινόμενου Ευρωπαϊκού μοντέλου σεισμικής διακινδύνευσης (ESRM20) και του τρόπου με τον οποίον λαμβάνεται υπόψη η επιρροή των τοπικών εδαφικών συνθηκών στην εκτίμηση της σεισμικής επικινδυνότητας. Η διάλεξη καταλήγει με την παρουσίαση εφαρμογών εκτίμησης της σεισμικής διακινδύνευσης σε διάφορες κλίμακες. Από την κλίμακα τεχνικού έργου και δικτύων υποδομών στην κλίμακα πόλης (Θεσσαλονίκη, Αθήνα), χώρας (Ελλάς), ακόμη και της Ευρώπης.

Σύντομο βιογραφικό Κυριαζή Πιτιλάκη,

Ομότιμου Καθηγητή ΑΠΘ, Προέδρου της Ευρωπαϊκής Ένωσης Σεισμικής Μηχανικής (ΕΑΕΕ)

Ο Ομότιμος Καθηγητής Κυριαζής Πιτιλάκης είναι απόφοιτος του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης και Διδάκτωρ της Ecole Centrale de Paris. Από τον Ιούνιο του 2018 είναι Πρόεδρος της Ευρωπαϊκής Ένωσης Αντισεισμικής Μηχανικής (ΕΑΕΕ). Διετέλεσε Πρόεδρος του Τμήματος Πολιτικών Μηχανικών του ΑΠΘ, του Ινστιτούτου Τεχνικής Σεισμολογίας και

Αντισεισμικών Κατασκευών (ΙΤΣΑΚ), της Τεχνικής Επιτροπής "Earthquake Geotechnical Engineering and Associated Problems" (TC203) της Διεθνούς Ένωσης Εδαφομηχανικής και Γεωτεχνικής Μηχανικής, και του Ελληνικού Τμήματος Αντισεισμικής Μηχανικής (ΕΤΑΜ). Από το 2019 είναι επισκέπτης καθηγητής στο Tongji University, Shanghai-China, στο International Joint Research Laboratory of Earthquake Engineering (ILEE). Το εργαστήριο το οποίο έχει δημιουργήσει στο Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης είναι από τα σημαντικότερα στο αντικείμενο του στην Ελλάδα και την Ευρώπη, με σύγχρονο εξοπλισμό και πλούσιο ερευνητικό και εφαρμοσμένο έργο στην εδαφοδυναμική, την γεωτεχνική μηχανική και την σεισμική μηχανική. Έχει συντονίσει και συμμετάσχει ενεργώς σε πολλά σημαντικά Ευρωπαϊκά και Εθνικά ερευνητικά προγράμματα. Μεταξύ των πλέον εμβληματικών ερευνητικών του έργων είναι η δημιουργία και η συνεχής από το 1995 λειτουργία του ερευνητικού πεδίου δοκιμών EUROSEISTEST όπως και ο συντονισμός του ερευνητικού προγράμματος SYNER-G. Εξίσου σημαντικές είναι και οι διάφορες διεθνείς του δραστηριότητες όπως η διοργάνωση στην Θεσσαλονίκη του 4ου Διεθνούς Συνεδρίου Γεωτεχνικής Σεισμικής Μηχανικής το 2007 και του 16ου Πανευρωπαϊκού Συνεδρίου Σεισμικής Μηχανικής το 2018. Το συγγραφικό του έργο περιλαμβάνει περισσότερες από 600 επιστημονικές δημοσιεύσεις σε επιστημονικά περιοδικά, πρακτικά διεθνών συνεδρίων και βιβλία που καλύπτουν ένα ευρύ φάσμα αντικειμένων στην εδαφομηχανική, την εδαφοδυναμική, την γεωτεχνική μηχανική και την σεισμική μηχανική. Διαθέτει πλούσια επαγγελματική εμπειρία στην Ελλάδα και το εξωτερικό και πλούσια εμπειρία στην σύνταξη αντισεισμικών κανονισμών, του Ευρωκώδικα 8 συμπεριλαμβανομένου. Έχει υπάρξει εκδότης (editor) τεσσάρων βιβλίων στον εκδοτικό οίκο Springer σε θέματα σχετικά με την σεισμική μηχανική, είναι μέλος πλήθους επιστημονικών επιτροπών συνεδρίων και συντακτικών επιτροπών περιοδικών, και κριτής διεθνούς εμβέλειας επιστημονικών περιοδικών. Έχει προσκληθεί ως κύριος ομιλητής σε πλήθος εθνικών και διεθνών συνεδρίων. Φοιτητές του κατέχουν σημαντικές ακαδημαϊκές θέσεις σε πολλά πανεπιστήμια και ερευνητικά ινστιτούτα στην Ελλάδα και το εξωτερικό. Για τη συνολική του συνεισφορά στην επιστήμη τιμήθηκε το 2007 από την Γαλλική Δημοκρατία με το παράσημο του Ιππότη του Φοίνικα των Ακαδημαϊκών Γραμμάτων (Chevalier dans l'Ordre des Palmes Academiques).

ΑΡΘΡΑ

Doha Metro, Gold Line Project - Box Jacking/ Pushing Method for Tunnel Construction in Rock

Spyridon Konstantis & Spyros Massinas

ABSTRACT

The case of a box pushing tunnelling method in rock, on Doha Metro Gold Line project, successfully implemented to connect multiple entrance structures of Sport City station under a live traffic junction, in a heavy urban environment and under very shallow overburden is presented. Due to the size of the underpasses, the need to maintain uninterrupted traffic and the time-consuming utility diversions and reinstatement, the use of conventional NATM and Cut and Cover methods were assessed as either non-feasible or of high risk. The dimensions of the unsupported span, the encountered geotechnical conditions, the development of the settlements at road level and the box advance rate are presented.

Keywords: Tunnel, Box Pushing, Rock, Ram forces, Advance Rate

1 INTRODUCTION

The Doha Metro Gold Line Underground project is part of the rail network developed for the State of Qatar and was commissioned on 21st November 2019. The line crosses the centre of Doha (see Figure 1) and includes 11 underground stations (Msheireb interchange station is constructed by others), underground stabling facilities, approximately 15 km of 7.1 m diameter twin tunnels excavated with 6 EPB TBMs and 24 cross passages. The project was awarded to ALYSJ Joint Venture, formed by Aktor of Greece, Larsen & Toubro of India, Yapi Merkezi & STFA of Turkey and Al Jaber Engineering of Qatar. Sport City station, one of the major Gold Line stations, is located next to a major highway junction along Al Waab Street and in close proximity to the Khalifa Stadium. It has been designed and constructed as an event station to serve major athletic events and thus cater for the increased ridership. The configuration of the station required pedestrian access to be provided to the station via subways passing under each of these roads and hence the construction of three pedestrian underpasses serving the three quadrants of the junction (see Figure 2).

Figure 1 Gold Line overview map

The subway dimensions were selected to cater for the peak pedestrian traffic flows expected during sporting events and allow the installation of travellators and mechanical, electrical and plumbing (MEP) equipment. The required internal dimensions and lengths of the subways were: Subway 1: 13.1m width, 7.9m height and 80m length, and Subways 2 & 3: 7.9m width, 6.9m height and 50m length each.

1.1 Geology

The geological model of the area was developed based on ground investigation boreholes. The profile consisted of made ground and residual soil deposits to a maximum depth of 2.6 to 3 m (locally in areas of existing utilities the depth was up to 4m), followed by the upper Dammam formation and the Midra Shale below the base of the subways. The Dammam formation consists of the Simsima limestone which can be met on site in different weathering condition (from slight to moderate - extremely weak to very weak and moderately strong, light yellowish brown to greyish brown, dolomitic Limestone with pockets of silt/clay). The subways were constructed inside the moderate weathered Simsima limestone having a Young's modulus of 1GPa and a GSI range from 45 to 55. Figure 3 presents the geological profile along subway 1. The overburden height in Subway 1 varied from 3.5m to maximum 5m, while under Al Waab street the mean overburden height was only 4m. In Subway 2 the overburden height was 6m and in Subway 3 it varied from 4m to 6m.

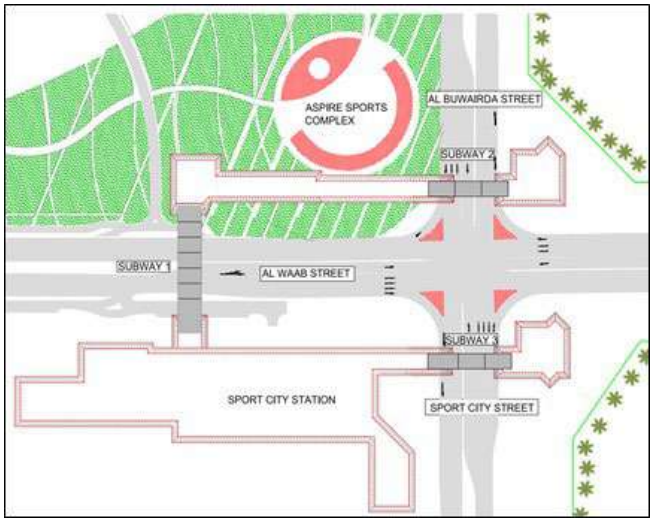

Figure 2 Sport City station configuration

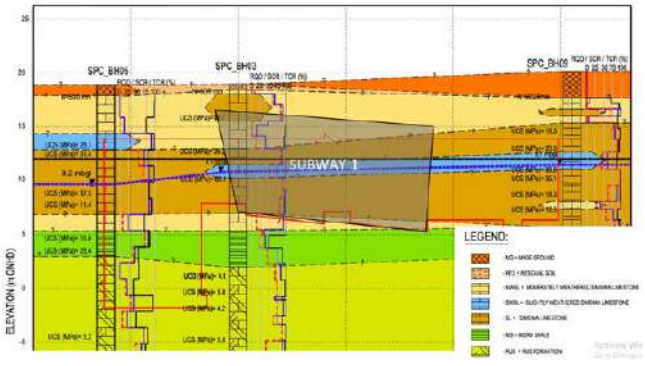

Figure 3 Geological profile along subway 1

1.2 Existing Utilities

Existing services were identified above the subways and within the zone of influence of the works, including TSE, foul sewer and potable water pipes, either INR, ductile iron or HDPE, ranging in diameter from 300 to 800mm (see Figure 4). The identified utilities were documented, assessed for adverse impact, continuously monitored and protected when deemed necessary. In one case, a steel utility bridge was constructed to support a pipe, transversely crossing the underpass.

1.3 Original Design

As per the original design proposed by the Contractor, the cut and cover construction method was to be adopted for

each of the subways, which however inevitably involved implementation of temporary traffic management schemes, lanes closures and diversions. Due to the close proximity of the station to the highway junction, a preliminary traffic impact assessment report indicated that this would lead to significant traffic disruptions not only at the Sport City junction but also in the surrounding areas and in part due to other concurrent construction activities across the city. That would lead to non-compliance with the contractual requirement to 'KEEP DOHA MOVING' (Qatar Railways Company, Employers Requirements) and hence, alternative solutions were sought and considered to avoid traffic disruptions and public nuisance and disturbance. The first construction method considered was the mined tunnel construction with conventional method (SCL/SEM/NATM), however this was excluded as an option due to geometrical constraints arising from the large size of the subways and the limited available ground cover (very low overburden height) of soil type formations. From a geological and geotechnical perspective, the underpasses would be excavated and constructed inside weathered and relatively weak limestone rock overlaid by made ground.

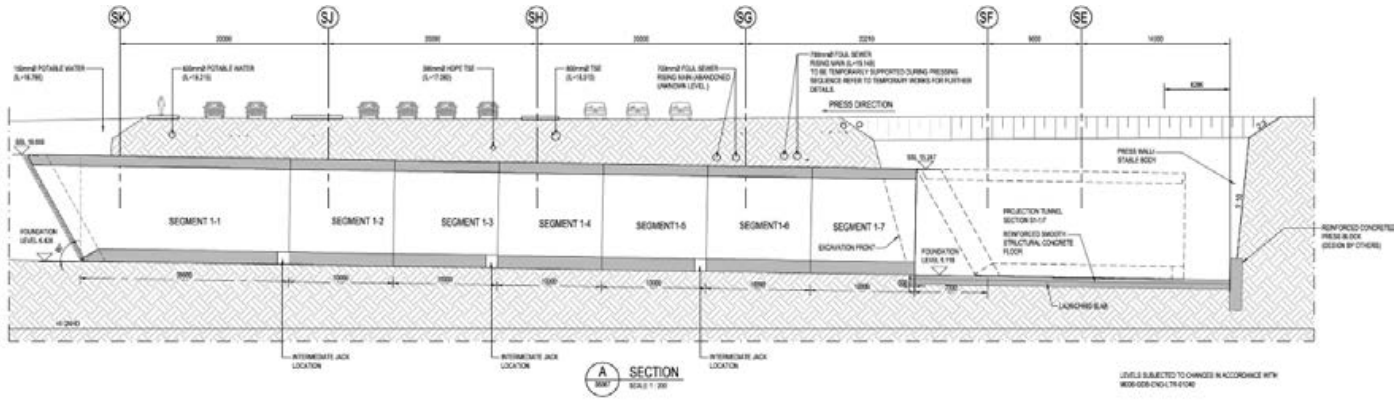

Figure 4 Longitudinal section of Subway 1 with utilities location

Design and construction related issues aside, a major constraint and decisive factor was also the very tight construction schedule with limited available activities duration and float. Following a rigorous comparative risk assessment, the box jacking/pushing method was selected for the three subways passing below the highways (see Figure 2), which was awarded by the Contractor to a specialist subcontractor, Petrucco of Italy. Most if not all of the recorded box jacking/pushing cases are in soil formation and therefore the prevailing ground conditions (weak rock) in Sport City resulted in a unique construction method (excavate and push rather than push inside the ground and excavate inside the box), a first in the Middle East region, and as per authors' knowledge unique worldwide. In the following, the design scheme and construction sequence is presented, together with detailed design inputs for the jacking loads, settlement analysis, ground stability and structural analysis. In addition, the challenges faced during construction are also presented, including settlement protection of utilities, effects of over excavation and lessons learnt. The subways were successfully constructed between 2016 and 2017 with no disruption to traffic.

2 DESIGN SCHEME AND GENERAL CONSTRUCTION SEQUENCE

The three jack box tunnels, consisting of a number of precast reinforced concrete segments, were constructed in launch pits positioned in such a way that they were laid either along the alignment of the pedestrian walkway or were located within the subway entrance profile. This allowed the excavation space to be re-used and reduced the construction programme. During construction of the jack box subways several segments were under construction simultaneously to reduce the total construction time. The segments were constructed sequentially and once completed, they were laterally jacked to the excavation face from where they were jacked into their final position (see Figure 5).

A summary of the construction sequence is as follow;

1) Excavate the launch pit to formation level and cast smooth concrete slab; 2) Cast first segment, reaction block and jack installations; 3) Excavate front face, lay sand on the base, shotcrete for any over excavation, and begin pushing sequence. Install ground beams as required to control alignment. Excavation was limited to 500mm advancement length under the existing utilities in close vicinity with the box roof (until the segment overcame the full width of the utility pipes trenches). For more competent rock (see Figure 6) the excavation length increased up to 1m and even to 2m. Overexcavation was limited up to 20mm when underpassing critical utilities, while above 50mm, shotcrete was applied before jacking. The face was excavated in phases before the next push, i.e. first the left and right parts and then the middle part which acted as a buttress (see Figure 7). Above steps were repeated; 4) Concurrent with first segment pushing, next segments were cast in the launch pit (see Figure 5); 5) Dismantle the jack array and slide laterally the next segment into position; 6) Reassemble the jacking array and begin the pushing sequence again. Steps were repeated until all segments were in the final position; 7) Cast box segment stich details; 8) Connect jack box subways to cut and cover station box and entrance structures.

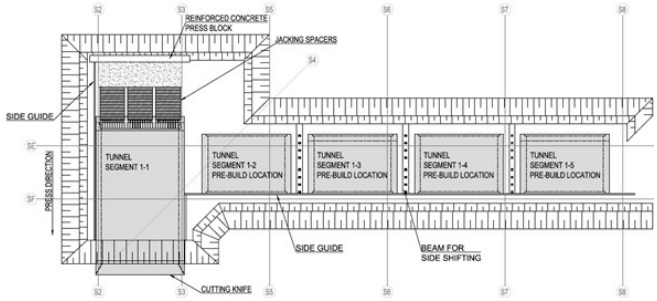

Figure 5 Subway 1 construction: Segments layout drawing and Box jacking sequence (top) and aerial photo (down).

Figure 6 Example of Face Mapping on Subway 1 for good rock conditions at the face

Figure 7 Excavation sequence with shotcrete application to control over-excavation

3 CONCRETE SEGMENTS DETAILS

A major risk associated with the box pushing method is the potential for the box segments to be "trapped" due to the friction between the segments and ground, resulting in major impacts for the construction programme. Several measures were adopted to reduce this risk. Firstly, intermediate jacks were located between the box segments to allow the segments to be pushed individually (intermediate jacking stations every 20m of underpass), reducing the loads and providing construction flexibility. The adjoining segments were also connected with 20mm thick steel plates anchored into the segment with shear studs that could slide freely to open and closed positions (see Figure 8). The steel plates acted to restrain the segments from becoming misaligned and in addition assisted to avoid the segments jack-knifing.

A protection shield (see Figure 9, left) all around the front part of the first segment was constructed. This shield was designed to reinforce the front part against any falling rocks and accidental damages during the excavation. The shield arrangement allowed the construction teams to reach the whole perimeter of the excavation using hammers or mills or use small hand-hammers to refine the excavation profile. It was also designed to be easily removable and allow the teams to reach the structural couplers that were positioned underneath it without damaging or cracking the concrete structure.

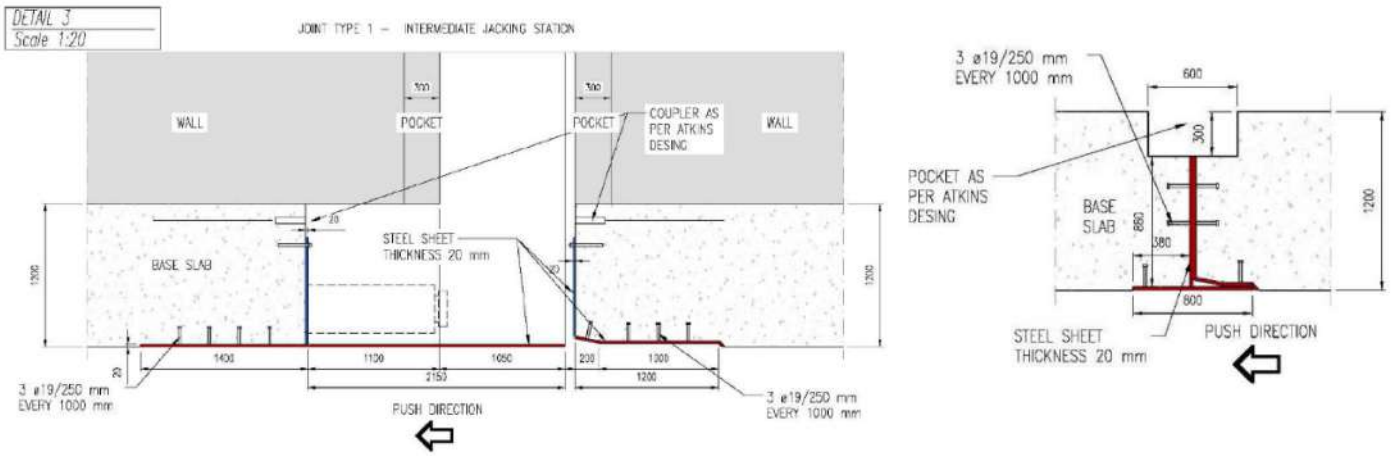

Figure 8 Detailed arrangement for intermediate (left) and for non-intermediate (right) jacking station.

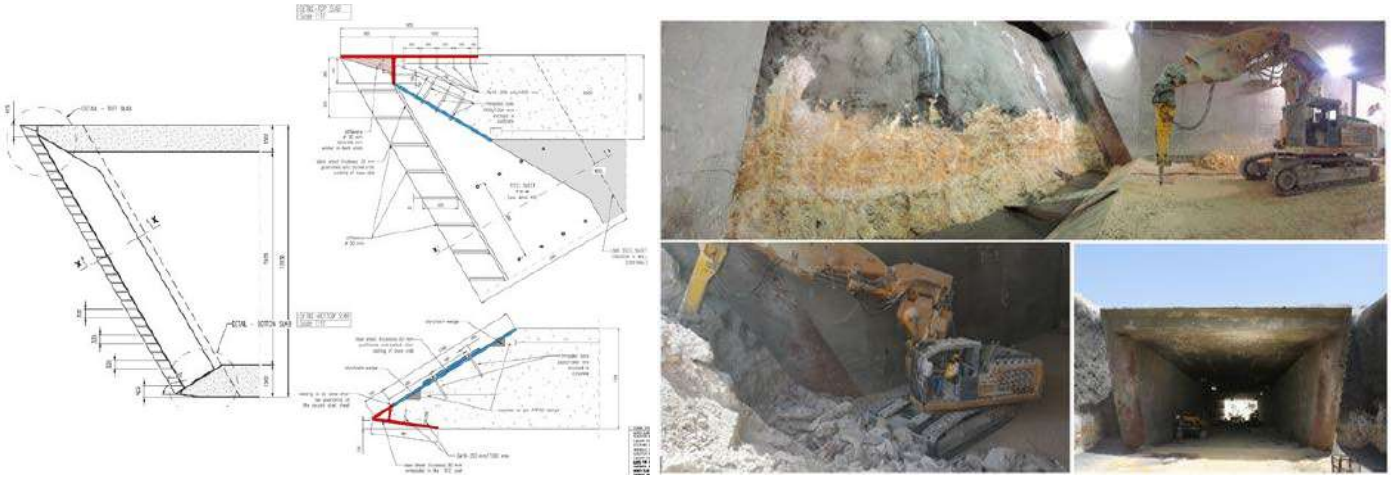

Figure 9 Detailed arrangement of front shield (left) and photographs during construction (right) (Inside Subway 1, top; final breakthrough, bottom; Protection shield is visible at the front part)

4 JACKING LOADS

In order to minimise or even eliminate the risk of the segments being 'jammed' during the pushing operations (which would have very adverse impact on the construction progress), it was considered necessary to be conservative with the determination of the maximum capacity for pushing the segments and hence ensure that there would be sufficient jacking force with available safety margin. This was achieved by calculating the maximum jacking forces based on the frictional resistance of the ground applied to the roof, walls and base slab i.e. the total perimeter. Based on the experience presented by Petrucco, a coefficient of friction of 0.5 was adopted and applied. The front segment S1 was placed 3m away from the entry point into the ground in order to verify the adopted friction coefficient. The hydraulic jacks were grouped and housed together in steel cradles and positioned to apply loads only to the base slabs.

Figure 10 presents the recorded forces of the jacking rams (main rams with counteraction on the reaction wall and intermediate rams between the segments every 20m). The 'saw' scheme of the recorded values is due to overcoming the friction before sliding of the segment in each jacking step.

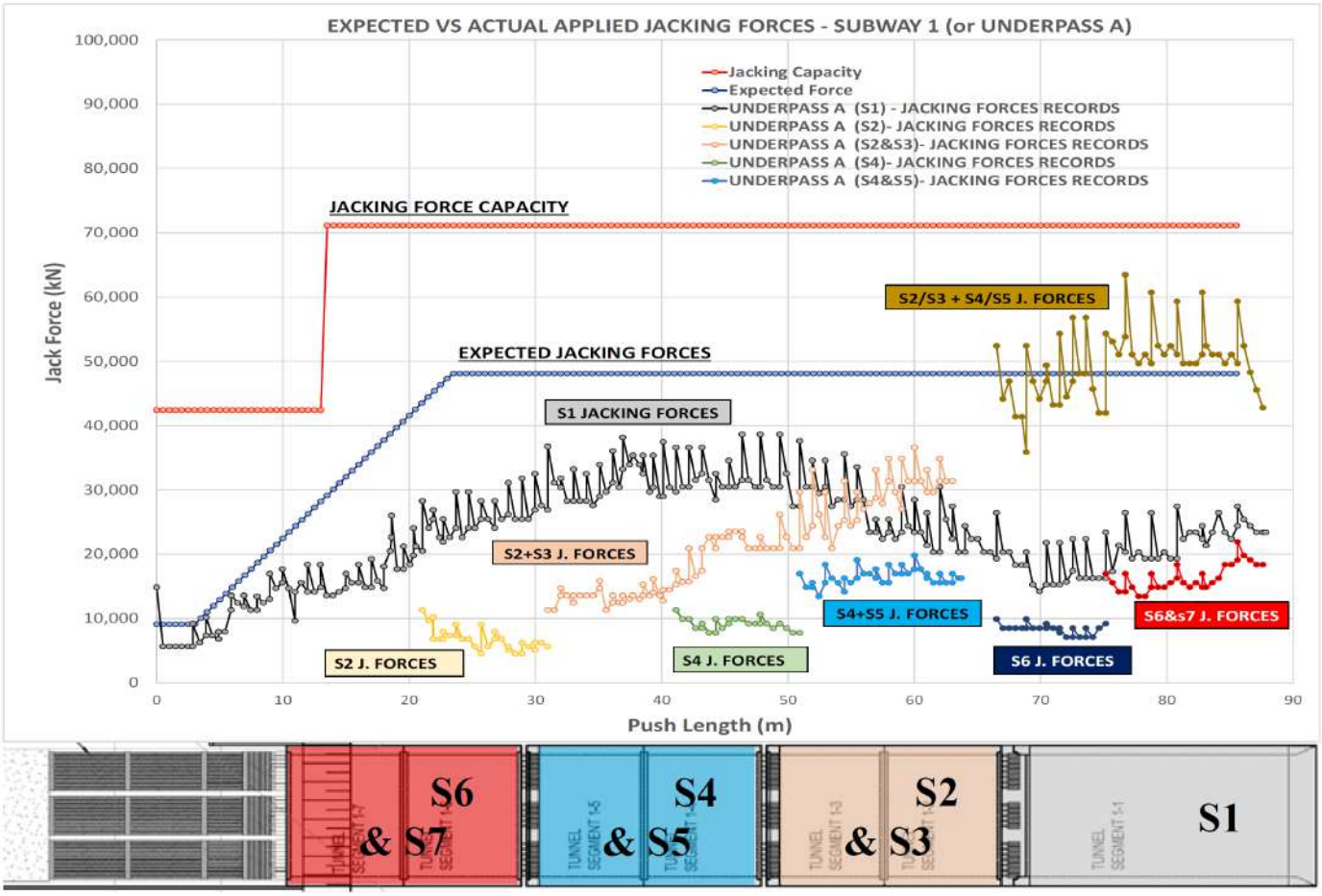

Figure 10 Hydraulic jacks – Designed vs Actual applied forces in each jacking station

5 DETAILED DESIGN OF THE CONCRETE SEGMENTS

The relatively high ground stiffness, compared to the more softer ground conditions where the jack box method is traditionally used, meant that the construction methodology and design would have to be modified. Firstly, it would not be possible to push the cutting knife of the first pushed segment into the ground during the pushing sequences. The excavation had therefore to take place in advance of the cutting knife and be larger than the box perimeter to facilitate the jack box pushing sequence. The over excavation could have adverse impact on the surface settlements and it was intended therefore to be limited. The proposed solution was to limit the advance excavation and to use shotcrete to fill any over excavations around the perimeter. This sequence of events required a design verification that the ground would be self-supporting and the magnitude of the surface settlements within acceptable limits. In addition and due to the use of shotcrete for over excavation limitation, additional design verifications had to be carried out for the worst case of shotcrete bonding to the box perimeter. A 3-D solid element soil-structure interaction finite element model (FEM), incorporating all construction sequences, was adopted in the commercially available software LUSAS (see Figure 11, left). A shear strength reduction analysis was adopted to verify the factor of safety of the cutting face slope with a factor of safety of 1.25. The results of the analysis proved that a 300 to 500mm excavation advancement would provide adequate safety and limit settlements to within acceptable limits. For face stability, a 60 slope was recommended to be adopted, however it was also proven through the analysis that a 75 slope could also be safely adopted, to allow for construction tolerances and provide a safe minimum angle.

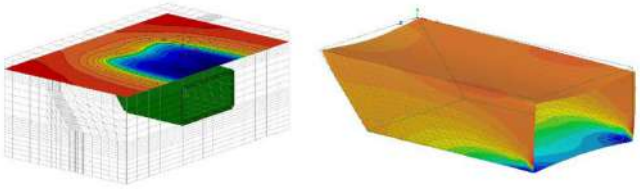

Figure 11 Soil-structure interaction model showing vertical displacement contours (left), and, 3D shell element model showing axial stresses induced by jacking loads (right)

A series of numerical analysis was carried out with a variety of geotechnical parameters to create an envelope of the stress state in the concrete segments. For example the case of no lateral ground loads due to over excavation has been examined. This load combination was critical for the design of the roof slab to limit the crack widths within contract's specifications. To cover the case with full lateral loads due to grouting through grout sockets embedded in the walls, roof and base slabs another load combination with a K=0.9 was adopted. It is noted that contact grouting was applied in the perimeter only after the final breakthrough. To verify the global behaviour of the box segments subjected to the maximum capacity of the jacks, a second 3-D model was built, adopting shell elements (see Figure 11, right). The loads were applied to the base slab and the frictional resistance to the perimeter of the model. Subsequent stress checks were made to ensure that the section did not exceed the allowable tensile capacity of the concrete and bursting reinforcement was added to each base slab (EN 1991-1-2004. Design of Concrete Structures). As mentioned above, additional design verifications were carried out for the worst case of shotcrete bonding to the box perimeter. The minimum concrete cover to reinforcement was 55mm as required for durability on the external face. An additional 30mm was provided as sacrificial concrete for abrasion based on previous experience, equating to a total cover of 85mm.

6 INSTRUMENTATION AND MONITORING (I&M)

Due to the criticality of the box pushing operations being continuously carried out under a busy carriageway and live utilities with limited overburden, a robust real-time instrumentation and monitoring regime was installed, comprising level points installed near utility trenches, extensometers and asphalt road points (see Figure 12a).

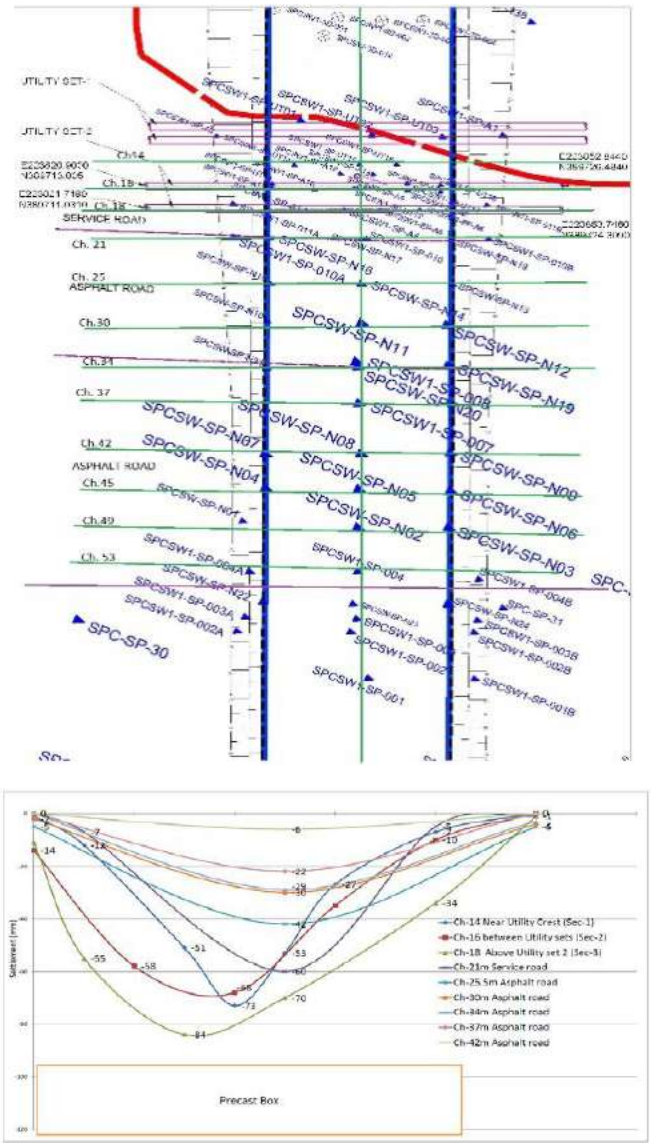

Figure 12 I&M Plan with settlement section lines (top) and measured surface settlements transverse to the box pushing operation (down) – Subway 1

Prior to the commencement of the box pushing operations, it was identified through site surveys and determined from the analysis, that the first set of utilities to be encountered located below the service road (see Figure 4) would require appropriate protection as diversion was not an option due to schedule constraints. Further investigations and liaison with the utility owners, revealed that only one set of utilities was live and had to be protected. It was consequently decided to protect these live utilities and suspend them from a utility steel bridge, given also the poor compaction level of the trench backfill identified through site investigations. As foreseen and anticipated (see Figure 12, right and Figure 13), the backfill of these utilities trenches exhibited increased settlements - mainly attributed to the low rock cover in this area and possibly the dynamic compaction of the backfill during the hammer and road-header excavation. However no adverse impact was experienced by the live utilities protected

by the steel bridge.

From the ground settlement results, it can be seen from the section lines above the asphalt road where the rock cover was in the order of 3-4 m (excluding the sections above the utilities and adjacent to these due to the proximity interaction) that the overlying rock exhibited a 'bridge' response with a remarkable deformation line similar to a loaded 'restrained beam'. In the very limited cases where ground deformations exceeded the allowable limits or caused damage to the surface areas and paved roads, those were reinstated by ALYSJ JV.

The overexcavation above the roof of the pre-cast boxes, was the main parameter for controlling the development and the magnitude of the surface settlements. The rock quality (moderate weathered Simsima limestone with Young's modulus stiffness of 1 GPa and GSI range of 45 to 55) proved competent with increased "stand up time" while the maximum actual overexcavation varied between 50mm and 100mm.

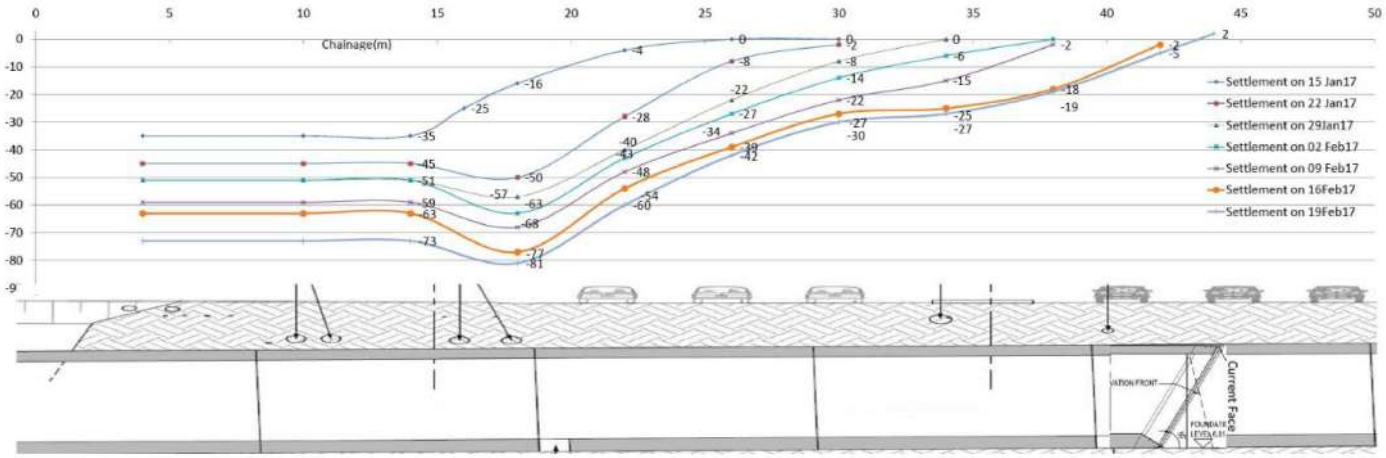

Figure 13 Measured surface settlements along Subway 1

7 CONCLUSION

Despite the tight and challenging schedule constraints and the low cover, the box pushing operations were concluded successfully and the settlements and ground deformations were within the acceptable levels. It was remarkable to observe the behaviour of the rock mass for the unsupported length. Through the application of the box pushing construction method, there was no disturbance and negative impact on the high traffic volume and the construction works were completed prior to the contractual milestone.

ACKNOWLEDGEMENTS

The authors would like to thank Qatar Rail and ALYSJ JV for their permission to publish this article.

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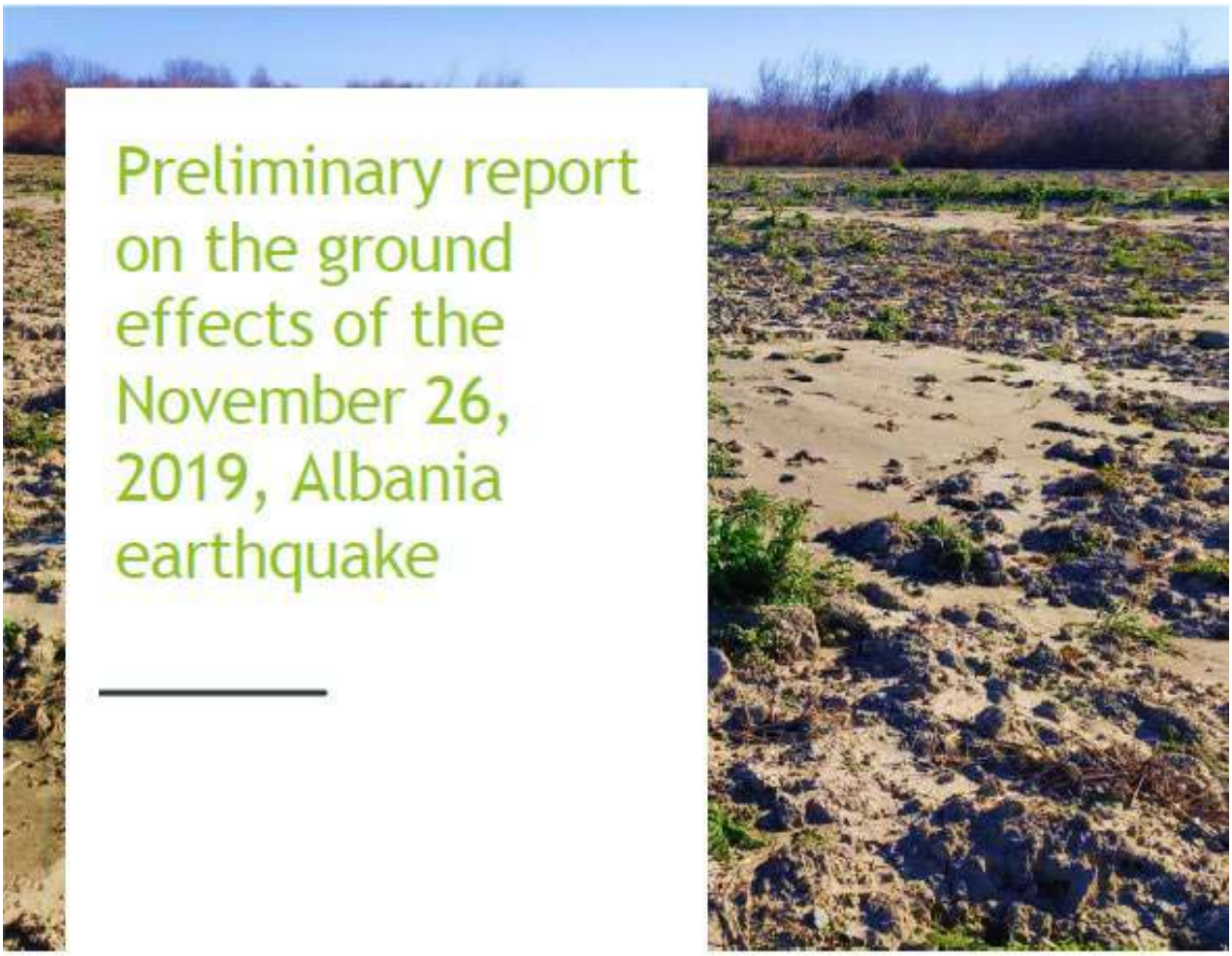
Qatar Railways Company, Employers Requirements

Το άρθρο παρουσιάσθηκε στο **International Conference on Civil Infrastructure and Construction (CIC 2020) February 2-5, 2020 Qatar University, Doha, Qatar** και βραβεύθηκε με το **Best Paper Award** στο **Theme 3: Geotechnical Engineering and Geo-environmental Engineering**.



Preliminary report on the ground effects of the November 26, 2019, Albania earthquake

EARTHQUAKE GEOLOGY RESEARCH TEAM
DEPARTMENT OF GEOLOGY
ARISTOTLE UNIVERSITY OF THESSALONIKI

Preliminary report on the ground effects of the November 26, 2019, Albania earthquake

1 Introduction

This report summarizes the field observations performed by members of the Earthquake Geology Research Team of the Department of Geology (Aristotle University of Thessaloniki, Greece - AUTh) in collaboration with colleagues from the Polytechnic University of Tirana (UPT) and the associated Institute of Geosciences, Energy, Water and Environment (IGEWE), as shown in Table 1.

Department of Geology AUTh	***Polytechnic University of Tirana***
Spyros Pavlides, Prof. Emeritus	Arjan Beqiraj, Prof. (UPT)
Alexandros Chatzipetros, Assoc. Prof.	Ylber Muceku, Assoc. Prof. (IGEWE)
George Georgiadis, MSc, PhD student	Hamza Reçi (IGEWE)
Ilias Lazos, MSc, PhD student	

TABLE 1. MEMBERS OF THE RESEARCH TEAM FROM BOTH INSTITUTES INVOLVED IN THIS REPORT.

Fieldwork has taken place during the period immediately after the earthquake and until early January 2020. The main ground effects of this earthquake consist of mainly soil liquefaction and secondary lateral spreading in specific areas, accompanied with limited rockfalls and landslides.

2 Earthquake properties

The earthquake had a magnitude of 6.4, although different magnitudes and source characteristics are given by various institutes (Figure 1). As is evident from the beachballs, the event was an almost purely compressional one. Previous studies in the area, based mainly on seimic tomography data, indicate a low-angle basal thrust dipping towards the NE and at least one steep backthrust dipping towards the SW. This structural manifestation is in good agreement with the focal mechanisms of Figure 1.

The area is characterized by contraction, as it is the outermost continental thrust belt of the Albanides. The main indications of contraction in the area, apart from focal mechanisms of recorded earthquakes, are a series of NW-SE trending fold axes that are parallel to each other and perpendicular to the inferred active maximum stress axis (σ_1). Thrusts, which also accommodate this contractional tectonic regime, are typicall not reaching the surface and are considered to be blind ones, forming the core of the mapped anticlines. Given also that the epicentral depth was high (>20 km), the structure of the area is consistent with the observed ground effects that are in their entirety secondary induced ones. Primary effects (i.e. fault ruptures) were ont observed in the affected area.

Widespread damage was observed in buildings throughout the meisoseismal area. The most severe cases were the collapse of hotels and residential buildings in Durrës and Thumanë, which unfortunately led to human loss.

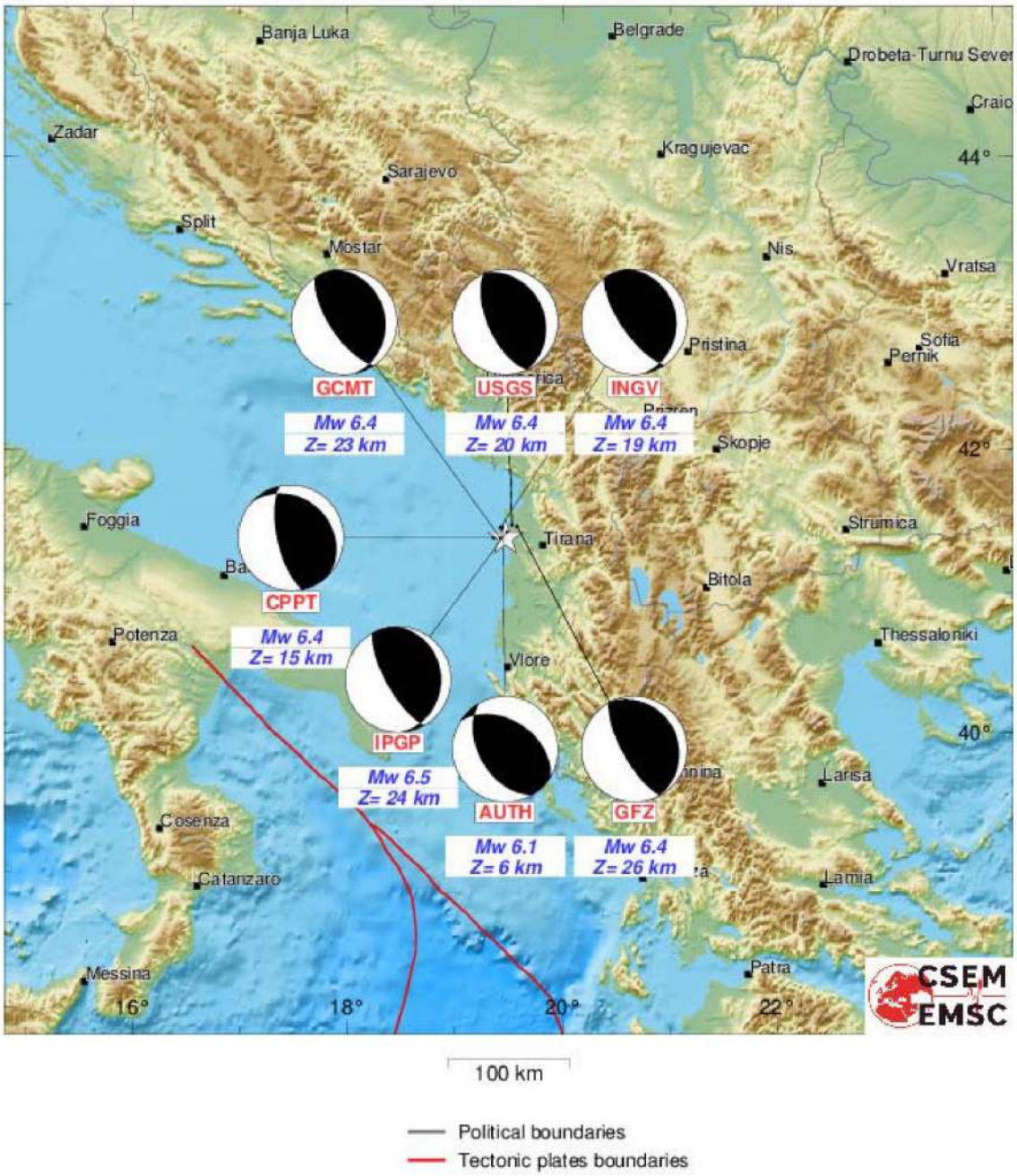


FIGURE 1. FOCAL MECHANISMS AND ASSOCIATED EPICENTRES OF THE MAIN SHOCK, AS GIVEN BY VARIOUS INSTITUTES (SOURCE: EMSC).

3 Distribution of effects

The effects are mainly distributed in three areas of particularly poor geotechnical properties (Figure 2):

1. Area 1: Durrës Beach.
2. Area 2: Rrushkull area.
3. Area 3: Fushë Kuqe area.

The following paragraphs summarize in brief the ground effects in each area.

FIGURE 2. GENERALIZED LOCATION MAP OF THE AREAS IN WHICH LIQUEFACTION WAS OBSERVED: 1. DURRËS BEACH, 2: RRUSHKULL AREA, 3: FUSHË KUQE AREA.

3.1 Durrës beach

The most severe damages in the area of Durrës were observed in the area bordering the beach, SE of the city. Three hotels collapsed (Miramare Hotel, Vila Verde and Lubjana Hotel), and several more buildings were damaged beyond repair (Figure 3, Figure 4 and Figure 5). At least one of the cases (Miramare Hotel), the collapse is associated with liquefaction, as is evident from the ejected sand (Figure 6).

In this case, damages may be associated with poor geotechnical conditions, as the buildings are built on coastal sand deposits with a very shallow water table. The varied response to the earthquake (i.e. destroyed buildings next to intact ones) is an indication of differentiated build quality, which may also have played a significant role in the distribution of damages.

FIGURE 3. SITE OF THE COLLAPSED MIRAMARE HOTEL IN DURRËS BEACH.

FIGURE 4. SITE OF VILA VERDE HOTEL IN DURRËS BEACH,

FIGURE 5. EXAMPLE OF A DAMAGED BUILDING IN DURRËS BEACH. DAMAGE OF LOWER FLOORS IN HIGH-RISING BUILDINGS WAS COMMON DUE TO THE SITE-SPECIFIC STRONG MOTION PROPERTIES.

FIGURE 6. LIQUEFIED EJECTA AT THE COLLAPSED MIRAMARE HOTEL SITE.

3.2 Rrushkull area

This is a flat area that is controlled by the interaction of the meandering river and the coast. Satellite images show a clear interplay between the river and the coast development. The flat morphology has led to the deposition of loose fine to medium grained alluvial sediments. In these sediments widespread liquefaction was observed, together with lateral spreading along the riverbanks.

Liquefaction was frequently observed along cracks (Figure 7 and Figure 8), while in other cases the source of the liquefied sand was not possible to be identified. In any case, the sand was of the same properties, (i.e. grain size, color, etc.), which is consistent with previous geotechnical investigation in the broader area, which indicates that layers of fine light gray sand are present throughout the area.

Of particular importance in this area are the lateral spreading effects that were observed along the riverbanks (Figure 9 and Figure 10). The location of the main ones is shown in Figure 11. They are mostly parallel to the riverbanks and are attributed to local failures due to the shaking during the earthquake.

The most prominent of those crack sets is observed at the area close to the estuary (Figure 12), where a complex set of cracks accompanied by liquefied ejected sand has been formed.

The cracks had a general trend parallel / subparallel to the riverbank (NE-SW), while the longest (northern branch) show a rather uniform displacement vector towards the NW. A small vertical displacement of up to 15 cm is also evident in some cases along the crack (Figure 13 to Figure 16).

FIGURE 7. SURFACE RUPTURE AND EJECTED SAND.

FIGURE 8. EXAMPLE OF LIQUEFIED SAND IN THE FIELDS SW OF RRUSHKULL.

FIGURE 9. TYPICAL LATERAL SPREADING ALONG THE RIVERBANKS IN RRUSHKULL AREA.

FIGURE 10. LATERAL SPREADING ALONG THE RIVERBANKS IN RRUSHKULL AREA.

FIGURE 11. LOCATION OF LATERAL SPREADING CRACKS (YELLOW LINES) ALONG THE BANKS OF THE RIVER SOUTH OF RRUSHKULL.

FIGURE 12. MAPPED LATERAL SPREADING NEAR THE RIVER EASTUARY IN AREA 2. LIQUEFACTION WAS WIDESPREAD ALONG THE SOUTHERN BRANCHES.

7

FIGURE 13. PART OF THE SOUTHERN BRANCHES OF THE LATERAL SPREADING NEAR THE RIVER ESTUARY.

FIGURE 14. DETAIL OF EJECTED SAND ALONG A CRACK.

FIGURE 15. PART OF THE CRACK SET, CLOSE TO THE RIVERBANKS NEAR THE ESTUARY.

FIGURE 16. VERTICAL DISPLACEMENT OF UP TO 15 CM WAS EVIDENT IN CERTAIN PLACES ALONG THE CRACK.

3.3 Fushë Kuqe area

This area has many common geological-geotechnical characteristics with the Rrushkull one. A shallow water table is developed in alluvial deposits, with the main difference being the existence of gravels that can be seen in a gravel pit next to the river north of Gurëz village. In this area, liquefaction was observed in the fields, as well as in the area of boreholes (Figure 17). In one case, which the only site where this was observed, liquefaction caused the ejection of not only sand, but gravel as well (Figure 18). A sample from this site is currently under analysis.

FIGURE 17. LIQUEFIED SAND IN GURËZ AREA.

FIGURE 18. ACCORDING TO REPORTS, LIQUEFACTION AT THIS SITE STARTED WITH GRAVELS THAT WERE EJECTED FIRST, FOLLOWED BY SAND. THE SAMPLING SITE IS ALSO VISIBLE.

Along the coast of Patok Lagoon some limited surface cracks (Figure 19) and lateral spreading (Figure 20) were also observed, but the are interpreted as secondary features due to poor geotechnical conditions with no direct association with primary earthquake effects.

According to sime reports from local fishermen, some liquefaction phenomena were also observed at the beach west of Adriatik village, however this has not been able to confirm due to very difficult approach and time constraints.

FIGURE 19. A CRACK AT A PARKING LOT NEXT TO PATOK LAGOON.

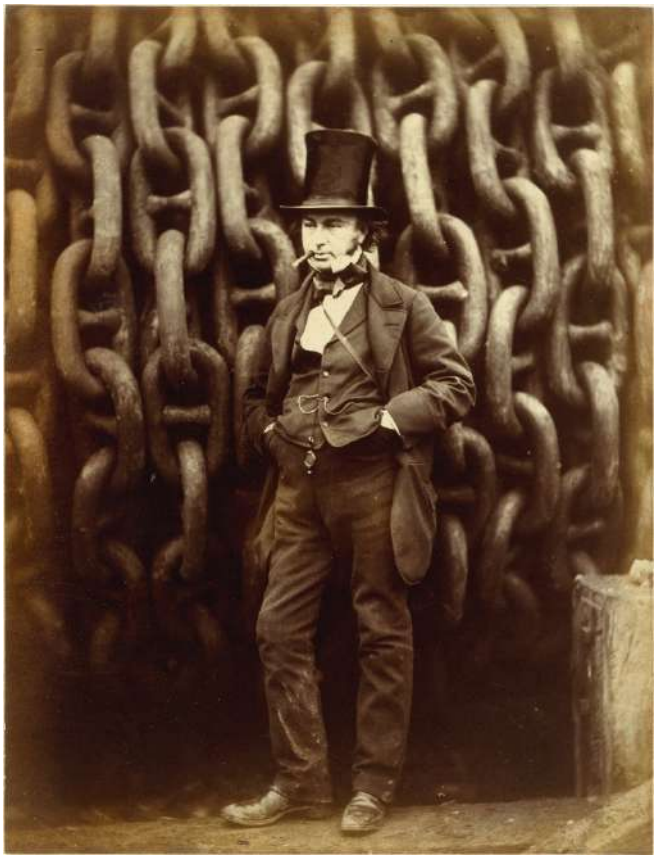
FIGURE 20. SMALL-SCALE MASS MOVEMENT DUE TO LATERAL SPREADING NEXT TO PATOK LAGOON.

10

Late great engineers: Isambard Kingdom Brunel

One of the best-known engineers of the 19th Century – if not the best-known engineer of all time – Isambard Kingdom Brunel achieved greatness in railway, civil and maritime engineering. By Nick Smith

In 2002, the BBC conducted a poll of the '100 Greatest Britons'. While there can be few eyebrows raised at the winner – statesman Winston Churchill – to have an engineer sit in second place, above the likes of William Shakespeare, Captain James Cook and Queen Victoria, seems to say something about just how highly the British prize their Industrial Revolution heroes. The engineer in question was Isambard Kingdom Brunel.



These days, Brunel's fame is greater than our knowledge of his achievements. While those within the engineering community will know that he designed the Clifton Suspension Bridge, Paddington Station and iron transatlantic ships, it's unlikely that those outside will remember Brunel as the man behind the Great Western Railway, and even a hospital in the Crimea that was to establish the blueprint for how field medical facilities are built to this day.

Isambard Kingdom Brunel was born in Portsmouth on 9th April 1806 during the reign of George III, shortly after the creation of the United Kingdom of Great Britain and Ireland. It was a time of social and political unrest across Europe, with Brunel's father, French civil engineer Marc Isambard Brunel (a royalist sympathiser) forced to escape the French Revolution by fleeing to the United States, while his mother Sophia Kingdom was arrested as an English spy during the Reign of Terror. The couple were eventually reunited in England where they started a family shortly after the turn of the century. Their son was named Isambard, a Germanic name of Norman origin meaning 'iron-axe'.

By the time Brunel junior was eight years old, he was fluent in French and familiar with Euclidian geometry. Following a stint at boarding school in Hove (where he learned classical languages), he continued his education at Lycée Henri-IV (now the University of Caen Normandy) in Paris while his father languished in debtor's prison with a liability of £5000. On graduating, Brunel studied as an apprentice to the leading clock maker Abraham-Louis Breguet, after which he returned to England in 1822. His first appointment was with his now released father, working as assistant engineer on a River Thames tunnel project to connect Rotherhithe with Wapping, during which time he was nearly killed in a flooding incident. The tunnel eventually became part of the London Underground and remains in use today.

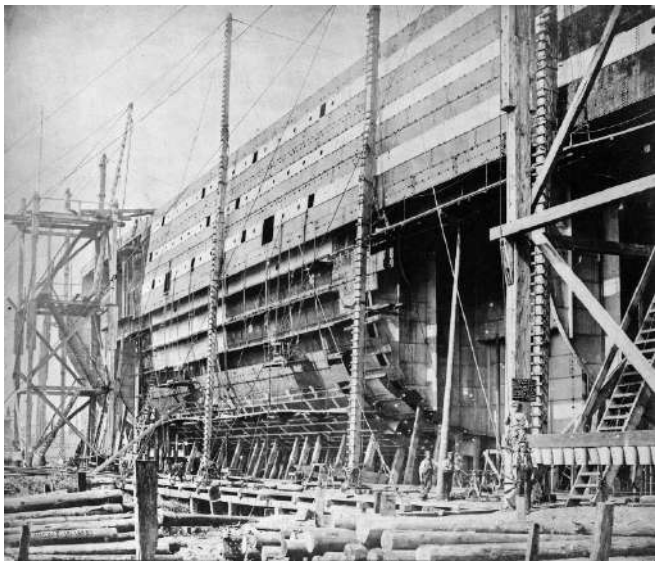
Although his public recognition rests heavily on one of the most significant feats of Victorian bridge building, the idea that Brunel designed the Clifton Suspension Bridge is contested. It is a matter of record that Brunel submitted four designs for the bridge (all of which were rejected by the 'Colossus of Roads' Thomas Telford in favour of one of his own designs). It is also beyond doubt that further designs by Brunel eventually won a competition (and more importantly, public opinion) to reinstate him as the designer. But the bridge itself, that would not be completed until 1864 (five years after the engineer's death), substantially differs from Brunel's original vision. Less controversial are the Hungerford Bridge – a suspension footbridge close to Charing Cross station in London – the Royal Albert Bridge in Saltash near Plymouth, the Somerset Bridge, the Windsor Railway Bridge and the Maidenhead Railway Bridge, the last of which was the widest brick arch bridge in the world and is still in service, despite today's trains being ten times heavier than they were in Brunel's time.

By 1833 Brunel was chief engineer of the Great Western Railway, a company that had been founded to reinforce Bristol's prominence as Britain's second port and primary point of departure for merchant trade to America. Brunel's largest project to date, the London-Bristol line received its enabling Act of Parliament in 1835, with the first trains running in 1838. Brunel chose a 7 ft (2,134 mm) 'broad gauge' for his railway, based on his calculations and trials for stability and comfort at high speed (later increasing this by a quarter of an inch to reduce friction in the wheel sets while negotiating curves). But with the Birmingham and Gloucester railway operating on a 4 ft 8 1⁄2 in (1,435 mm) standard gauge, the ensuing incompatibility meant that passengers travelling from south to north needed to change trains to continue their journey. The so-called 'gauge war' led to the appointment by Parliament of the Gauge Commission that reported in favour of the standard gauge and, apart from exceptions made for parts of the GWR, the broad gauge was phased out entirely.

The gauge war has done little to overshadow Brunel's achievement in designing the Great Western Railway's London terminus at Paddington. Influenced by Joseph Paxton's Crystal Palace that housed the Great Exhibition of 1851, it remains one of the capital's most important stations and, despite being extended and rebuilt after sustained bombing throughout the Second World War, is still recognisable as Brunel's design. A life-size bronze statue of Brunel by John Doubleday is located between Platforms 8 and 9. The same sculptor has a standing statue of Brunel in Bristol, at the other end of the line.

One of Brunel's lesser successes was his 'atmospheric railway'. The 'vacuum traction' system was intended to provide an alternative to steam power, in which locomotives were propelled along the track by means of a continuous jointed cast iron slotted pipe that lay between the rails connected to a pumping station, with pressure maintained by a longitudinal leather flap along the slot. The patented system came from shipbuilders and engineers Joseph and Jacob Samuda who, along with gas engineer Samuel Clegg, were able to produce encouraging tests in London. When put in practice on a section of the South Devon Railway, there were reliability problems with the seals and valves. The whole enterprise

is described in 'The Iron Road: The Illustrated History of Railways' as an 'expensive flop.'



The Great Eastern under construction at Millwall.

Brunel's vision for the Great Western Railway had always been to extend Britain's rail network across the Atlantic Ocean to America via a sea route from Bristol to New York. The technical issue facing Brunel in the mid 1830s was based on the assumption that ships powered purely by steam weren't capable of making commercially viable voyages of such magnitude. It was a matter of practicality, as the fuel required would take up all the space available in the cargo hold. However, Brunel managed to prove that while the amount of cargo a ship could carry increased by the cube of its dimensions, the resistance it experienced only increased by the square. The implications were obvious: the bigger the ship, the less fuel proportionally required. Brunel offered his services to the Great Western Steamship Company pro bono and was rewarded with the commission to design their first vessel, the Great Western, a predominantly wooden craft with steam-powered paddle wheels, the longest ever built at 236ft (72m). The ship went into regular service – 64 crossings between 1838 and 1846 – and was so successful that Brunel was asked to design another.

Great Britain was even bigger at 322ft (98m). But, more significantly, was propeller-driven and built of metal: as such, widely regarded at the first modern ship. Success was short-lived, with Great Britain meeting misfortune only one year into service, when it ran aground off the coast of Ireland due to navigation error. It was subsequently sold for salvage and is now a ship museum in dry dock in Bristol. The third of Brunel's ships – the Great Eastern – was larger still, carried a complement of 4,000 passengers and was capable of cruising from London to Sydney and back without refuelling. The ship failed to become commercially successful as a passenger vessel and was repurposed as a sub-oceanic telegraph cable-layer, so playing a role in opening up telecommunications between Europe and North America.

While Brunel was working on the Great Eastern, Florence Nightingale was tending the military sick and wounded of the Crimean War at the British Army Hospital at Scutari, notorious for its unsanitary conditions that caused outbreaks of cholera, dysentery, typhoid and malaria. Nightingale wrote to the Times to force the government to provide a solution. The task was handed to Brunel, who in the space of five months managed to assemble a team to design, build and ship a prefabricated complex of wood and canvas buildings to the Dardanelles in 16 ships. The resulting hospital at Renkioi was an overwhelming success, with a 90 percent improvement on patient recovery compared with Scutari.

Brunel died on 5th September 1859 at the age of 53, shortly after the ill-fated maiden voyage of the Great Eastern, during which it was extensively damaged by an explosion.

(THE ENGINEER, 12th February 2020, https://www.theengineer.co.uk/late-great-engineers-isambard-kingdom-brunel)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular January 2020
www.issmge.org/news/issmge-news-information-circular-january-2020

1. SYDNEY 2021 – 20ICSMGE, 7iYGEC – PAPER ALLOCATION INFORMATION AND CALLS FOR ABSTRACTS

All member societies were sent information on paper allocation on the 19th December 2019. If you have not seen these details, please let the ISSMGE Secretariat (secretariat@issmge.org) know as soon as possible.

2. ISSMGE Awards

Member Societies are hereby called to submit nominations for ISSMGE awards for the 20th International Conference on Soil Mechanics and Geotechnical Engineering to be held in Sydney, Australia, in September 2021. Nominations should be submitted to the Secretary General by the closing date of 1 July 2020. For more information and guidelines for the nomination of the various awards please click here.

3. Tables of Giroud et al. (1972-1973)

The French Society (CFMS) is happy to announce the on-line publication of "Tables pour le calcul des fondations par Giroud et al. (1972-1973) - Édition numérique". Please go to: http://www.geotech-fr.org/publications/tables-de-giroud

4. Proceedings from the XVI Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVI PCSMGE 2019) now available in open access.

The Innovation and Development Committee of ISSMGE is pleased to announce that through the initiative of Dr. Norma Patricia López Acosta on behalf of the XVI PCSMGE Organizing Committee, the 356 papers from the proceedings and the invited lectures volumes of XVI Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVI PCSMGE) held in Cancun, Mexico, on November 17-20, 2019 are available in the online library here: https://www.issmge.org/publications/online-library

Detailed acknowledgements for the XVI Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVI PCSMGE) can be found on the ISSMGE online library acknowledgements section.

5. TC Guidelines – update

An updated set of Guidelines for the ISSMGE Technical Committees and Honour Lectures are now available from the website - https://www.issmge.org/filemanager/article/390/Guidelines_for_ISSMGE_Technical_Committees_revised_Nov19.pdf

6. ISSMGE Online Library – Open Access

The ISSMGE Online library (https://www.issmge.org/publications/online-library) is in continuous development – please note the following additions:

17th African Regional Conference on Soil Mechanics and Geotechnical Engineering;

17th European Conference on Soil Mechanics and Geotechnical Engineering,

Australia New Zealand conference series back catalogue.

7. TC306 Geo-Engineering Education Survey - A message from the Officers of TC306

Dear ISSMGE member,

If you are an instructor in a civil engineering department, please contribute to a TC306 Geo-Engineering Education survey. The title of the survey is "What Geotechnical Engineering Educational Material can we dream of?"

If you have very limited time but don't want to miss the opportunity to contribute, just jump to Question 11 (the only required): Please imagine and describe the "educational material of your dreams".

You will find the questionnaire here: https://www.surveymonkey.com/r/TC306

Best regards,

Marina Pantazidou and Michele Calvello

(Chair and Secretary of TC306)

8. Are We Overdesigning? A survey of international practice

A joint initiative by the CAPG, the YMPG, TC2015 - Safety and Serviceability and TC304 - Risk. The survey is intended to assess the consistency of calculation models and design methods for a variety of geotechnical structures, and where possible, to compare the results with full scale tests and reliability analyses. To participate in the survey please go to https://www.issmge.org/news/are-we-overdesigning-a-survey-of-international-practice.

9. Bulletin

The latest edition of the ISSMGE Bulletin (Volume 13, Issue 5, Oct 2019) is available from the website from: https://www.issmge.org/publications/issmge-bulletin/vol-13-issue-5-october-2019.

10. ISSMGE Foundation

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 31st January 2020. Click here for further information on the ISSMGE Foundation.

11. Conferences

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.

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

ISSMGE Events

INTERNATIONAL CONFERENCE ON CHALLENGES AND ACHIEVEMENTS IN GEOTECHNICAL ENGINEERING - 11-06-2020 - 13-06-2020

POLIS University campus, Tirana, Albania; Language: English; Organiser: Albanian Geotechnical Society; Contact person: Erdi Myftaraga; Phone: +355699336911; Email: emy@greengeotechnics.com

ISSMGE News & Information Circular January 2020

www.issmge.org/news/issmge-news-information-circular-february-2020

1. SYDNEY 2021 – 20ICSMGE, 7iYGEC – PAPER ALLOCATION INFORMATION AND CALLS FOR ABSTRACTS

All member societies were sent information on paper allocation on the 19th December 2019. If you have not seen these details, please let the ISSMGE Secretariat (secretariat@issmge.org) know as soon as possible.

2. ISSMGE Awards

Member Societies are hereby called to submit nominations for ISSMGE awards for the 20th International Conference on Soil Mechanics and Geotechnical Engineering to be held in Sydney, Australia, in September 2021. Nominations should be submitted to the Secretary General by the closing date of 1 July 2020. For more information and guidelines for the nomination of the various awards please click here.

3. Council Meeting Cape Town, 6th October 2019

Please note that the Minutes of the Council Meeting held in Cape Town in October 2019 have been finalised and are now available from the website at https://www.issmge.org/the-society/council-meeting-minutes

4. **Tables of Giroud et al. (1972-1973)**

The French Society (CFMS) is happy to announce the on-line publication of "Tables pour le calcul des fondations par Giroud et al. (1972-1973) - Édition numérique". Please go to http://www.geotech-fr.org/publications/tables-de-giroud

5. TC Guidelines – update

An updated set of Guidelines for the ISSMGE Technical Committees and Honour Lectures are now available from the website - https://www.issmge.org/filemanager/article/390/Guidelines_for_ISSMGE_Technical_Committees_revised_Nov19.pdf

6. ISSMGE Online Library – Open Access

The ISSMGE Online library (https://www.issmge.org/publications/online-library) is in continuous development – please note the following additions:

- 17th African Regional Conference on Soil Mechanics and Geotechnical Engineering;
- 17th European Conference on Soil Mechanics and Geotechnical Engineering,
- Australia New Zealand conference series back catalogue,
- XVI Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVI PCSMGE 2019)
- 9th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, Sao Paulo, 2017 (TC204)

7. Are We Overdesigning? A survey of international practice

A joint initiative by the CAPG, the YMPG, TC2015 - Safety and Serviceability and TC304 - Risk. The survey is intended to assess the consistency of calculation models and design methods for a variety of geotechnical structures, and where possible, to compare the results with full scale tests and reliability analyses. To participate in the survey please go to https://www.issmge.org/news/are-we-overdesigning-a-survey-of-international-practice.

8. Bulletin

The latest edition of the ISSMGE Bulletin (Volume 13, Issue 6, Dec 2019) is available from the website from: https://www.issmge.org/publications/issmge-bulletin/vol-13-issue-6-december-2019

9. ISSMGE Foundation

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 31st May 2020. Click here for further information on the ISSMGE Foundation.

10. Conferences

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.

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

ISSMGE Events

3RD PAN-AMERICAN CONFERENCE ON UNSATURATED SOILS, 25-01-2021 - 28-01-2021

PUC-Rio, in Rio de Janeiro, Brazil; Organiser: Tácio de Campos (PUC-Rio), Fernando Marinho (USP), Gilson Gitirana (UFG), Contact person: Tácio de Campos; Email: panam2021unsat@puc-rio.br; Website: https://panamunsat2021.com

THE 1ST INTERNATIONAL CONFERENCE ON SUSTAINABILITY IN GEOTECHNICAL ENGINEERING – GEODIVERSITY & RESILIENCE (1ST ICSGE'21) - 27-06-2021 - 30-06-2021

The Congress Center of LNEC, Lisbon, Portugal; Language: English; Organiser: The National Laboratory for Civil Engineering (LNEC); Contact person: LNEC Congress Centre Secretariat; Address: Avenida do Brasil, 101 1700-066 Lisboa; Phone: (+351) 218 443 483; Email: formacao@lnec.pt; Website: http://icsge.lnec.pt/

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

iCGE'20 International Conference on Geotechnical Engineering (ICGE) Innovative Geotechnical Engineering, 09-11 March 2020, Hammamet, Tunisia, www.icge20.geolab.tn

1st International Symposium on Construction Resources for Environmentally Sustainable Technologies (CREST 2020), March 10 to 12, 2020 in Fukuoka, Japan, https://crest2020.com

ECPMG 2020

4th European Conference on Physical Modelling in Geotechnics

15 - 17 March 2020, Luleå, Sweden

https://www.ltu.se/research/subjects/Geotechnical-engineering/Konferenser/ECPMGE-2020?l=en

The 4th European Conference on Physical Modelling in Geotechnics, ECPMG 2020, is organised by the Soil Mechanics research group at Luleå University of Technology, under the auspices of the TC104 Technical Committee of Physical Modelling of the International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE).

The time for the conference is Sunday evening March 15th until Tuesday evening March 17th 2020.

Contacts

If you have any questions, please contact us via ecpmg@ltu.se or one of the contacts below

Laue, Jan - Professor and Head of Subject, Chaired Professor

Organisation: Soil Mechanics, Mining and Geotechnical Engineering, Department of Civil, Environmental and Natural Resources Engineering

Phone: +46 (0)920 491288
Email: jan.laue@ltu.se
Room: F1053 - Luleå

GeoAmericas2020 4th Pan American Conference on Geosynthetics, 26-29 April 2020, Rio de Janeiro, Brazil, www.geo-americas2020.com

Ημερίδα
"Ο Ρόλος της Γεωμορφολογίας στη Σύγχρονη Κοινωνία"
29 Απριλίου 2020, Αθήνα

Στο πλαίσιο των δραστηριοτήτων της, η **Επιτροπή Γεωμορφολογίας και Περιβάλλοντος** της Ελληνικής Γεωλογικής Εταιρείας σε συνεργασία με το **Τμήμα Γεωγραφίας του Χαροκοπείου Πανεπιστημίου** και το **Τμήμα Γεωλογίας και Γεωπεριβάλλοντος του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών**, διοργανώνει **Επιστημονική Ημερίδα με θέμα "Ο ρόλος της Γεωμορφολογίας στη Σύγχρονη Κοινωνία"**, την **Τετάρτη 29 Απριλίου 2020** στην **Αίθουσα Τελετών του Χαροκοπείου Πανεπιστημίου Αθηνών.**

Μεταξύ των κύριων στόχων της Ημερίδας είναι:

- η παρουσίαση και συζήτηση των αποτελεσμάτων της σύγχρονης έρευνας σε όλους τους τομείς της γεωμορφολογίας,
- η εφαρμογή νέων, καινοτόμων, τεχνικών και μεθόδων στη γεωμορφολογική έρευνα,
- η εκτίμηση μελλοντικών προβλέψεων σε ό,τι αφορά στη διαμόρφωση του γήινου ανάγλυφου υπό το πρίσμα της κλιματικής αλλαγής,
- η ενίσχυση του ρόλου της γεωμορφολογίας στη σύγχρονη εποχή και της συμβολής της στην πρόληψη, ετοιμότητα και προσαρμογή των κοινωνιών στους φυσικούς κινδύνους,
- η "ενεργοποίηση" των νέων γεωμορφολόγων και η ενθάρρυνση της μεταξύ τους συνεργασίας.

Οι θεματικές περιοχές της Ημερίδας καλύπτουν όλα τα επιμέρους γνωστικά αντικείμενα της γεωμορφολογίας όπως: παράκτια και υποθαλάσσια γεωμορφολογία, ποτάμια γεωμορφολογία, καρστική γεωμορφολογία, τεκτονική γεωμορφολογία – μορφοτεκτονική, παγετώδης γεωμορφολογία, εφαρμοσμένη γεωμορφολογία, τεχνικές και μέθοδοι γεωμορφολογικής χαρτογράφησης, γεωαρχαιολογία, παλαιογεωγραφία και αναπαράσταση παλαιοπεριβαλλόντων, γεωλογία Τεταρτογενούς, φυσικοί κίνδυνοι και καταστροφές.

Η Ημερίδα απευθύνεται σε γεωεπιστήμονες (μέλη της επιστημονικής κοινότητας, ακαδημαϊκοί και ερευνητές, στελέχη της δημόσιας διοίκησης και της τοπικής αυτοδιοίκησης, κ.ά.) που

δραστηριοποιούνται στα παραπάνω γνωστικά αντικείμενα της γεωμορφολογίας και του περιβάλλοντος. Επιπλέον, αποσκοπεί να δώσει βήμα στους νέους και τις νέες γεωμορφολόγους που επιθυμούν να παρουσιάσουν τα ερευνητικά αποτελέσματα της προπτυχιακής ή μεταπτυχιακής διπλωματικής τους εργασίας ή της διδακτορικής τους διατριβής.

Το επιστημονικό πρόγραμμα της Ημερίδας θα περιλαμβάνει προφορικές και αναρτημένες ανακοινώσεις. Οι περιλήψεις που θα υποβληθούν θα αξιολογηθούν, θα τοποθετηθούν σε θεματικές ενότητες και θα παρουσιαστούν σε αντίστοιχες θεματικές συνεδρίες.

Η συμμετοχή στην Ημερίδα είναι δωρεάν και δεν υπάρχει περιορισμός στον αριθμό των περιλήψεων που μπορούν να κατατεθούν από έναν συγγραφέα.

Κατά τη διάρκεια της Ημερίδας προσκεκλημένοι ομιλητές θα δώσουν θεματικές ομιλίες για επιμέρους γνωστικά αντικείμενα της γεωμορφολογίας. Τα ονόματα των προσκεκλημένων ομιλητών θα ανακοινωθούν σύντομα.

WTC 2020 ITA-AITES World Tunnel Conference, 15-21 May 2020, Kuala Lumpur, Malaysia, www.wtc2020.my

Cities on Volcanoes 11 - Volcanoes and Society: environment, health and hazards, 23-27 May 2020, Heraklion, Crete, https://pcoconvin.eventsair.com/volcanoes11

14th Baltic Sea Geotechnical Conference 2020 Future Challenges for Geotechnical Engineering, 25 ÷ 27 May 2020, Helsinki, Finland, www.ril.fi/en/events/bsgc-2020.html

Nordic Geotechnical Meeting Urban Geotechnics, 25-27 May 2020, Helsinki, Finland, www.ril.fi/en/events/ngm-2020.html

5th Symposium of the Macedonian Association for Geotechnics
28 ÷ 30 May 2020, Ohrid, North Macedonia
mag@gf.ukim.edu.mk

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E-mail: mag@gf.ukim.edu.mk

ICED 2020 First International Conference on Embankment Dams: Dam Breach Modeling and Risk Disposal, 5 – 7 June 2020 in Beijing, China, http://iced-2020.host30.voosite.com

International Conference on Innovative Solutions for Geotechnical Problems in Honour of Prof. Erol Guler
11 - 12 June 2020, Istanbul, Turkey
www.isgpeg2020.org/en

As the organizing committee, we are pleased to invite you to the International Conference on "Innovative Solutions for Geotechnical Problems" in Honour of Prof. Erol Guler (ISGPEG2020)" at the Bogazici University in Istanbul-Turkey. This conference aims to gather a broad range of recent innovations in geotechnical engineering; testing, modelling, monitoring, field applications and risk analysis under the main topics of geotechnical engineering, geosynthetics, geotechnical earthquake engineering, and environmental geotechnics.

During this conference we will be happy to honor the distinguished professor of civil engineering - Prof. Erol Guler which is known as the leading geosynthetics scientist in Turkey. Professor Guler has made valuable contributions to geotechnical engineering in general and to the use of geosynthetics specifically in Turkey and throughout the World. He was instrumented in both research and also in the design of many geotechnical projects.

We are looking forward to seeing academicians, students, manufacturers, practitioners and designers in the geotechnical field at the ISGPEG2020 Conference. We want to extend a special invitation to engineers in general contracting firms, who will widely benefit from the Conference by learning more about the innovative solutions in geotechnical engineering to provide extraordinary financial and technical advantages.

We can guarantee that the ISGPEG2020 Conference will be an opportunity for all who attend to experience a valuable technical program, a magnificent city, and the essence of warm Turkish hospitality. The ISGPEG2020 will be valuable to geotechnical researchers and practitioners interested in all aspects of geotechnical engineering.

We are looking forward to meet you in Istanbul on June 11-12, 2020 to discuss creative and cost effective innovative solutions to geotechnical problems.

TOPICS

- Properties and Testing
- Geosynthetic Reinforced Walls, Slopes and Embankments
- Roads, Railways and Other Transportation Applications
- Pavements
- Tunneling and Underground space
- Deep excavation
- Hydraulic Applications
- Landfills
- Geosynthetic Barriers
- Drainage, Filtration and Erosion Control
- Physical and Numerical Models
- Soil dynamics and geotechnical earthquake engineering
- Foundations

- Soil improvement
- Sustainable Development and Green Technology
- Soil-Geosynthetic Interaction
- Lightweight Construction
- Long Term Performance and Durability
- Special and specific Issues
- Case histories

SCIENTIFIC SECRETARIAT

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International Conference on Challenges and Achievements in Geotechnical Engineering
11-13 June 2020, Tirana, Albania

Contact person: Erdi Myftaraga
Phone: +355699336911,
Email: emy@greengeotechnics.com

EUROCK 2020 Hard Rock Excavation and Support, 13-19 June 2020, Trondheim, Norway, www.eurock2020.com

DFI Deep Mixing 2020, 15 to 17 June 2020, TBD, Gdansk, Poland, www.dfi.org/DM2020

XIII International Symposium on Landslides - Landslides and Sustainable Development, June 15th – 19th 2020, Cartagena, Colombia, www.scg.org.co/xiii-isl

EGRWSE 2020 - 3rd International Conference on Environmental Geotechnology, Recycled Waste Materials and Sustainable Engineering, 18-20 June 2020, Izmir, Turkey, www.egrwse2020.com

GEE2020 International Conference on Geotechnical Engineering Education 2020, June 24-25, 2020, Athens, Greece, www.erasmus.gr/microsites/1168

E-UNSAT 2020 4th European Conference on Unsaturated Soils - Unsaturated Horizons, 24-06-2020 ÷ 26-06-2020, Lisbon, Portugal, https://eunsat2020.tecnico.ulisboa.pt

Geotechnical Aspects of Underground Construction in Soft Ground
29 June to 01 July 2020, Cambridge, United Kingdom
www.is-cambridge2020.eng.cam.ac.uk

ISSMGE Technical Committee TC204 is hosting the 10th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground (IS-Cambridge 2020) to be held in Cambridge, United Kingdom from June 29th to July 1st, 2020.

TC204 of the ISSMGE was first established in 1989 as TC28 and has made major commitments towards collecting information concerning the geotechnical aspects of the design, construction and analysis of deep excavations, tunnels and large underground structures in the urban environment. The first symposium was held in New Delhi in 1994 and eight more symposia were held in London (1996), Tokyo (1999), Toulouse (2002), Amsterdam (2005), Shanghai (2008), Rome (2011), Seoul (2014) and Sao Paulo (2017). TC204 decided to hold a tenth in Cambridge in 2020. The 10th symposium will be organised by TC204 of ISSMGE and the Geotechnical Research Group at the University of Cambridge.

The IS-Cambridge 2020 symposium will include themes in line with the terms of reference of TC204 such as tunnelling in soft ground, deep excavations, field monitoring, physical and numerical modelling, the effect of ground movements on existing structures and mitigation measures. The symposium will act as a platform to disseminate the most recent research and field developments in the design and construction of underground excavations in soft ground through keynote lectures and technical presentations.

Conference Themes

The themes for the Cambridge symposium, in line with the terms of reference of Technical Committee TC204, are as below.

Full papers will be made available to conference delegates and will be published in a printed Conference Proceedings by Taylor and Francis.

The Conference will attract an international audience of academics and practitioners. Presenters will be encouraged to highlight the theoretical insights and practical implications to a multi-disciplinary audience that is attracted to new, transformative ideas.

The first two days of the symposium will consist of technical sessions with presentations of General Reports and individual papers.

The third day will be dedicated to the technical visit to the work sites of the new Thames Tideway Tunnel project, which will be under construction at the time of the symposium. Delegates joining the technical visit will enjoy a memorable trip

to the project on a privately chartered boat on the River Thames in the heart of London.

Topics

- Field case studies
- Physical and numerical modelling of tunnels and deep excavations in soft ground
- The effect of underground construction activities on existing structures
- Design and application of ground improvement for underground construction
- Sensing technologies and monitoring for underground construction in soft ground
- Ground movements, interaction with existing structures and mitigation measures
- Seismic response of underground infrastructure in soft ground

Contact us

Information provided by: ifm-events@eng.cam.ac.uk

New Date ASIA 2020 Eighth International Conference and Exhibition on Water Resources and Renewable Energy Development in Asia, 30 June - 2 July 2020, Kuala Lumpur, Malaysia, www.hydropower-dams.com/asia-2020

16th International Conference of the International Association for Computer Methods and Advances in Geomechanics – IACMAG - CHALLENGES and INNOVATIONS in GEOMECHANICS, 01-07-2020 ÷ 04-07-2020, Torino, Italy, www.symposium.it/en/events/2020/16th-international-conference-of-iacmag?navbar=1

7th ICRAGEE International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, 13 – 16 July 2020, Bengaluru, India, http://7icragee.org

RTG^{2}EE - Recent Trends in Geotechnical and Geo-Environmental Engineering and Education, 15 – 17 July 2020, Bali, Indonesia, https://rtgee.org

5th Annual Urban Underground Space & Tunnelling conference, 20th – 22nd July 2020, Singapore, www.me-assets.com/HTMLEmail/AS-IF5361%20-%20Flyer.pdf

3rd International Conference on Geotechnical Engineering (ICGE – Colombo -2020), 10 - 11 August 2020, Colombo, Sri Lanka, http://icgecolombo.org/2020/index.php

ISFOH 2020 4th International Symposium on Frontiers in Offshore Geotechnics, 16 – 19 August 2020, Austin, United States, www.isfog2020.org

2020 CHICAGO International Conference on Transportation Geotechnics, August 30 - September 2, 2020, Chicago, Illinois, USA, http://conferences.illinois.edu/ICTG2020

EUROGEO WARSAW 2020 7th European Geosynthetics Congress, 6-9 September 2020, Warsaw, Poland, www.eurogeo7.org

37th General Assembly of the European Seismological Commission, 6 to 11 September 2020, Corfu, Greece, www.escgreece2020.eu

6th International Conference on Geotechnical and Geophysical Site Characterization "Toward synergy at site characterisation", 7 ÷ 11 September, Budapest, Hungary, www.isc6-budapest.com

7th International Conference on Industrial and Hazardous Waste Management 15th - 18th September, 2020, http://hwm-conferences.tuc.gr

14th International Congress on Advances in Civil Engineering
16-18 September 2020, Istanbul, Turkey
www.ace2020.org/en

Welcome to the 14th International Congress on Advances in Civil Engineering (ACE2020) that will be held in Istanbul, Turkey, September 16-18, 2020. The congress aims to bring together state-of-the-art research and their applications in all fields of civil engineering, while you can enjoy unique social and cultural atmosphere in the city of Istanbul.

The traditional ACE Congresses have been hosted every two years by one of the organizing universities: Boğaziçi University, Eastern Mediterranean University, Istanbul Technical University, Karadeniz Technical University, Middle East Technical University and Yıldız Technical University, with the support of Turkish Chamber of Civil Engineers.

With this tradition, ACE 2020 is planned as the 14th of now well established ACE Congress series. It will provide a great opportunity for high-level researchers and professionals to present their most recent research and case studies, and get feedback from peers and colleagues who have similar interests.

TOPICS

- Building Materials
- Construction Management
- Geotechnics
- Hydraulics
- Mechanics
- Structures
- Transportation

SCIENTIFIC SECRETARIAT

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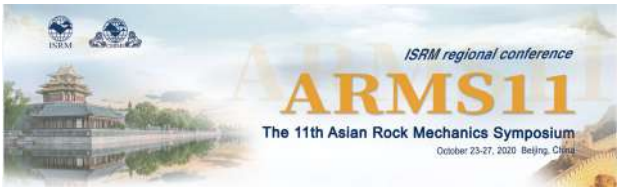
27th European Young Geotechnical Engineers Conference and Geogames, 17 – 19 September 2020, Moscow, Russia, https://t.me/EYGEC2020

ICEGT-2020 2nd International Conference on Energy Geotechnics, September 20-23, 2020, La Jolla, California, USA, https://icegt-2020.eng.ucsd.edu/home

EUROENGEO 3RD EUROPEAN REGIONAL CONFERENCE OF IAEG, 20-24 September 2020, Athens, Greece, www.euroengeo2020.org

Fourth International DAM WORLD Conference, 21-25th September 2020, Lisbon, Portugal, https://dw2020.lnec.pt

New Date 88th ICOLD Annual Meeting & Symposium on Sustainable Development of Dams and River Basins, 26th September – 1st October 2020, New Delhi, India, https://www.icold2020.org



11th Asian Rock Mechanics Symposium, Challenges and Opportunities in Rock Mechanics
23 ÷ 27 October 2020, Beijing, China
www.arms11.com

On behalf of Chinese Society for Rock Mechanics and Engineering (CSRME, ISRM NG China), we are pleased to invite you to Beijing for the 11th Asian Rock Mechanics Symposium (ARMS 11), which will be held on October 23-27, 2020, in conjunction with China Rock 2020.

The theme for ARMS 11 is "Challenges and Opportunities in Rock Mechanics". The technical program will focus on advances and innovative applied research on rock mechanics and rock engineering. It will provide a showcase of recent developments and advances in rock mechanics and innovative applications in rock engineering. It will offer an international forum for exchanging new ideas and exploring the future directions in rock mechanics and engineering. Short courses, workshops, industrial exhibitions and technical visits will also be organized. Attractive programs will be provided for young researchers and students, including the student night, poster and paper competitions.

Theme and Topics

The theme for ARMS 11 is "Challenges and Opportunities in Rock Mechanics". Topics include but are not limited to:

- Analysis and design methods
- Numerical modeling
- Laboratory testing and rock properties
- Field measurements and site investigations
- Dynamics and blasting
- Fluid and gas flow
- Risk assessment and hazard mitigation
- Mining and rock support
- Tunneling, rock caverns, and underground space
- Rock slopes and foundations
- Underground storage
- Case histories of outstanding projects
- New frontiers and interdisciplinary research

Contact Us

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Website: http://www.arms11.com

HYDRO 2020 Strategies for future progress, 24-26 October 2020, Strasbourg, France, www.hydropower-dams.com/hydro-2020

3rd International Symposium on Coupled Phenomena in Environmental Geotechnics, October 29th – 30th, 2020, Kyoto, Japan, https://cpeg2020.org

5TH World Landslide Forum Implementation and Monitoring the USDR-ICL Sendai Partnerships 2015-2015, 2-6 November 2020, Kyoto, Japan, http://wlf5.iplhq.org

Fourth GeoMEast©2020 International Underground Structures Conference (IUSC), 8-12 November 2020, Cairo, Egypt, http://underground.geomeast.org

10th International Conference on Scour and Erosion (ICSE-10), November 15-18, 2020, Arlington, Virginia, USA, www.engr.psu.edu/xiao/ICSE-10 Call for abstract.pdf

6th ICFGE 2020
Forensic Geotechnical Engineering & Geo-Disaster Documentation
December 10-12, 2020 IIT Delhi, India
http://tc302-issmge.com

Forensic geotechnical engineering (FGE) involves scientific, legalistic investigations and deductions to detect the causes as well as the process of distress in a structure, which are attributed to geotechnical origin. Such a critical analysis will provide answers to "what went wrong, when, where, why, how, and by whom". Cases of remedied installations, particularly those which fall under public or government category, where the analysis and evaluation of adopted remedial measures with regard to their effectiveness and economy fall under this purview. FGE also gives strong inputs to improve analysis and design processes. This conference aims to develop a comprehensive framework for forensic engineering

procedures and post-failure reconnaissance studies of disaster management.

The International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) constituted a Technical Committee (TC) on Forensic Geotechnical Engineering (FGE) in 2005. During the first four years it was designated as TC40 and is now designated as TC302. This committee conducted five international seminars on FGE and is now organizing the sixth conference during December 10-12, 2020 at IIT Delhi, India.

Indian Institute of Technology, Delhi, Indian Geotechnical Society Delhi Chapter together with TC 302 of ISSMGE are organizing the event. The theme of the event is "Forensic Geotechnical Engineering & Geo-Disaster Documentation". The conference is supported by SPARC (Scheme for Promotion of Academic and Research Collaboration) of Government of India on the project "Advanced Technologies for Post-Disasters Reconnaissance, Forensic and Environmental Impact Studies - Geotechnical" which is a collaborative project among IIT Delhi, IISc, Bengaluru, Georgia Institute of Technology Atlanta, University of California, Davis and University of Cambridge.

This conference runs concurrently with the multidisciplinary mega event: 5th World Congress on Disaster Management (5WCDM).

The conference will develop mechanisms for strengthening collaboration between research and knowledge-based institutions as well as practitioners in the regions. It will evolve strategies for training, capacity development on the importance of disaster countermeasures and response preparedness in the regions by using advanced technologies for risk analysis mapping to a greater extent and to help address the deployment of research and analytical tools that leads to effective understanding of the data and its management. Understanding failures and natural disasters is one of the aspects of Forensic Geotechnical Engineering (FGE) and consists of following steps.

- Collection of Data
- Distress Characterization
- Development of Failure Hypothesis
- Diagnostic Tests
- Back Analysis
- Technical Shortcomings
- Legal Issues
- Use of Observation Methods
- Risk and Reliability Analysis
- Case Histories

Themes

- Geotechnical and geoenvironmental failure studies & development of remedial Measures.
- Advanced 3D mapping techniques in post-failure reconnaissance studies of disaster management.
- Evaluation of ground failures due to rainfall impact and earthquakes.
- Post-failure reconnaissance studies on vulnerability and risk analysis of geohazards.
- Vulnerability of slopes and the Challenges of Disaster Management
- Comprehensive study involving geological, geotechnical and geophysical investigations for landslides
- Mathematical modelling of active landslides
- multiplex Sensor Network System for Landslide Monitoring and Implementation
- Role of Geomatics Technologies in Geotechnical Studies.
- Methods in hazard & risk assessment of geohazards.
- Post Disaster Recovery & Management: Governance issues related to post disaster relief & rescue.
- Use of Machine Learning, Internet of Things, Data Analytics approaches

Get in Touch

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GeoAsia 2021

7th Asian Regional Conference on Geosynthetics
March 1-4, 2021, Taipei, Taiwan

The 1st Mediterranean Symposium on Landslides
Slope Stability Problems in Stiff Clays and Flysch Formations
7-9 June 2021, Naples, Italy
https://medsympland-slides.wixsite.com/msl2021

Landslides represent a relevant problem for most of the countries overlooking the Mediterranean. This trivial consideration should prompt researchers, professionals, and stakeholders in this region to form closer relationships and engage themselves in a continuous exchange of data and ideas to find common strategies of landslide risk mitigation.

A common problem concerns the stability of slopes in hard fissured soils, weak rocks and flysch deposits, which are widespread all over the region, posing major problems to the development of these areas. In the last decades, the geoengineering community has occasionally focused on these complex materials. In 1977 the Italian Geotechnical Society held an International Conference on "The Geotechnics of Structurally Complex Formations" in Capri. Sixteen years later, the Hellenic Society of Soil Mechanics and Foundation Engineering and the French Committee for Soil Mechanics

and Foundation Engineering jointly organized an international symposium in Athens on "The Geotechnical Engineering of Hard Soils and Soft Rocks" (1993). The Italian Geotechnical Society picked up on this initiative five years later, organizing the Second International Symposium on "The Geotechnics of Hard Soils and Soft Rocks" (Naples, 1998). Finally, in 2011, the Greek community organized the 15th European Conference of Soil Mechanics and Geotechnical Engineering in Athens, which was devoted to "The Geotechnics of Hard Soils and Weak Rocks".

It is evident that the behaviour of such a wide and complex class of materials, spreading across large areas in this corner of the world, cannot be interpreted simply through the basic laws of the Soil or Rock Mechanics. This is because they lay in a grey area between the two families of soils and rocks, showing distinct and special features, which are related to the origin of such materials and then to the geological processes which led to their deposition and evolution. On the other hand, it is just from all these complex settings that most of the problems arise, and it is to this that scholars and professionals should be devote their efforts.

With the goal in mind of urging the people living on the Mediterranean to join their efforts, we decided to organize a Mediterranean Symposium on Landslides (MSL) in Napoli in June, 2021, hoping that this initiative will be the first of a series of similar periodic events.

Topics

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Sessions

I. Geological Setting, Triggers and Mechanisms

This session is aimed at describing preparatory, conditioning and triggering factors and events. The main topic of this session will be the typology of slope failure processes which take place in these geomaterials, focusing in particular on the role of the geological structure and settings, the hydrologic regime, the soil properties and the natural stress field. Wide room is also left to description of the impact of weather, including climate changes, and of seismic activity on landslide triggering.

II. Investigations, Monitoring and Analysis

The scope of this session is to present data about the most relevant aspects of site and laboratory investigation, field monitoring and slope stability analysis from case studies of the Mediterranean region, accounting for the peculiar material properties and features of the slope response to triggers. The performance of different monitoring and investigation techniques will be discussed.

III. Remedial Measures, Landslide-Structure / Infrastructure Interaction

The scope of this session is to give room to some very important and often disregarded issues: i) the design, construction and performance of works aimed at slope stabilization or at mitigating the effects of slope movements; ii) the interaction between active landslides and man-made works, a typical problem in areas, occupied by unstable formations, where are located facilities and infrastructures. This should provide data and information useful to create a connection to risk and cost-benefit analysis, and to guide stakeholders in risk mitigation decisional processes.

Contact

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www.facebook.com/msl2021

The **9th edition of the International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2021)** will be organised on **13-16 June 2021** at the Chia Laguna resort, set on the enchanting Chia Bay, on the south western coast of Sardinia, Italy.

The previous eight editions of this conference were held on the islands of Santorini (Greece) on 25-28 May 2005, Ibiza (Spain) on 21-23 May 2007, Ischia (Italy) on 8-11 June 2009, Kos (Greece) on 20-22 June 2011, Ibiza (Spain) on June 17 - 19 June 2013, San Servolo, Venice, Italy on May 18 - 20 2015, on Rhodes Island, Greece on June 12 - 14 2017 and in Sitges, Spain on June 3-5, 2019

The objectives of **COUPLED PROBLEMS 2021** are to present and discuss state of the art, mathematical models, numerical methods and computational techniques for solving coupling problems of multidisciplinary character in science and engineering. The conference goal is to make step forward in the formulation and solution of real life problems with a multidisciplinary vision, accounting for all the complex couplings involved in the physical description of the problem.

The conference is one of the Thematic Conferences of the European Community on Computational Methods in Applied Sciences (ECCOMAS) and a Special Interest Conference of the International Association for Computational Mechanics (IACM). It is also supported by other scientific organizations in Europe and worldwide.

Conference Topics

The conference topics will include (the list is not exhaustive):

- Artificial Intelligence and Machine Learning Techniques
- Coupled solution strategies
- Loose and strong coupling schemes
- Mathematical formulation of multidisciplinary problems
- **Numerical Methods for Coupled Problems:** *Finite difference, Finite elements, Finite volume, Meshless methods, Particle methods, etc.*

- Optimum design in multi-disciplinary problems
- Parallel and Real Time computational techniques
- **Applications in science and engineering:**
  Bio-medicine and bio-mechanics
  Climate change
  Computational design of functional materials,
  Electro-magnetic-dynamics,
  Energy and environment
  Fluid-structure-interaction,
  Geomechanics,
  High performance computing,
  Industrial manufacturing processes,
  Multiphase flows
  Multiphysics problems,
  Multiscale problems,
  Optimization and control,
  Thermo-mechanical problems,
  Transport and mobility
  etc.

Conference Secretariat

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EUROCK TORINO 2021 - ISRM European Rock Mechanics Symposium Rock Mechanics and Rock Engineering from theory to practice, 21-25 June 2021, Torino, Italy, http://eurock2021.com

1st International Conference on Sustainability in Geotechnical Engineering
Geodiversity and Resilience

27-30 June 2021, Lisboa, Portugal
http://icsge.lnec.pt/#

The National Laboratory for Civil Engineering (LNEC) is pleased to announce that the 1st International Conference on Sustainability in Geotechnical Engineering, ICSGE, will be held in Lisbon, Portugal, from 27th to 30th June 2021.

Scope and aims

Sustainability is considered to be a top priority for all mankind by United Nations. With that goal in mind, ISSMGE technical committee TC 307, aims to monitor, produce and disseminate information regarding the contribution of geotechnical design and construction to a sustainable development.

This contribution includes adopting environment-friendly, cost-effective and socially-acceptable choices.

In line with United Nations concerns, the first conference on sustainability in geotechnical engineering is being organized by LNEC, with the following goals:

1. To contribute and to disseminate information on sustainability and resilience related issues in geotechnical engineering.
2. To offer an exceptional opportunity for exchanges between specialists in the various disciplines.
3. To offer the widest possible forum to young or new authors.
4. To give innovation an opportunity, by welcoming papers devoted to new materials, techniques and applications.
5. To give an outlook of the future.
6. To offer a high scientific and technical level to match the expectations of all participants.

Conference topics

a. Sustainability indicators, metrics and assessment tools in geotechnical engineering
b. Innovative, environmentally friendly and energy efficient geotechnical techniques
   - For site investigation
   - For waste containment
   - For remediation
   - For ground improvement
   - For construction
   - For monitoring
c. Sustainable use of geotechnical systems and materials
   - Minimization, reuse and recycling of waste materials
   - Smart materials
   - Retrofitting of foundations and other geotechnical structures
   - Life cycle assessment
d. Use and reuse of underground space for beneficial purposes
   - Storage of energy
   - Storage of carbon dioxide
e. Geotechnical techniques involved in the exploitation of renewable energy sources
   - Shallow and deep geothermal energies
   - Solar and wind energies
f. Socio-economic impacts from geo-activities
   - Mining and petroleum extractions
   - Dam construction
   - Waste disposal
g. Geohazard (man-made and natural) vulnerability and mitigation
   - Effects of global climate change
   - Multi-hazards
h. Practice of geoethics and maintaining geodiversity
i. Regulations on sustainability in geotechnical engineering
j. Education on sustainability in Geotechnical Engineering

Contact

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3rd International Conference on Natural Hazards & Infrastructure
Athens, Greece | June, 2021

ICONHIC2021 is coming to Athens

We are proud to announce that the 3rd International Conference on Natural Hazards & Infrastructure will take place in June 2021 in Athens, Greece.

2021 marks the 200 years of the Independence of the Greek State and the country's capital is preparing to commemorate this historic anniversary with iconic events throughout the year.

At ICONHIC2021, we proudly endorse these events and invite our delegates to jointly create a major conference, set to define a new era of progress, cooperation and new ideas.

GEOCHINA 2021 - 6th GeoChina International Conference Civil & Transportation Infrastructures: From Engineering to Smart & Green Life Cycle Solution, July 19 to 21, 2021, Nan-Chang, China, http://geochina2021.geoconf.org

3rd Pan-American Conference on Unsaturated Soils
25-28 July 2021, Rio de Janeiro, Brazil
https://panamunsat2021.com

Following the successful Pan-American Conferences on Unsaturated Soils held in Cartagena de Indias, Colombia (February, 2013), and in Dallas, Texas, USA (November, 2017), we invite you to attend the 3rd Pan-American Conference on Unsaturated Soils, which will be held in the city of Rio de Janeiro, Brazil, in July of 2021. The conference will deal with advances in unsaturated soil mechanics and discuss current and future trends in practical applications. You will feel the unique warmness the *cariocas'* hospitality and have the opportunity to experience a modern city that presents itself as a real-scale laboratory of unsaturated soil mechanics.

Preliminary Conference Topics

- Barriers
- Case Histories
- Composite Materials
- Education
- Embankments
- Expansive and Collapsible Soils
- Field Measurements
- Foundations
- Fundamentals
- Geotechnics of Roads
- Laboratory Testing
- Numerical Modelling
- Slopes
- Soil Properties
- Soil-Vegetation-Climate Interaction
- Tailings Engineering

Contact panam2021unsat@puc-rio.br

5th International Workshop on Rock Mechanics and Engineering Geology in Volcanic Fields
9÷11 September 2021, Fukuoka, Japan

Contact Person: Prof. Takatoshi Ito
E-mail: jsrm-office@rocknet-japan.org

7th International Young Geotechnical Engineers Conference
A Geotechnical Discovery Down Under
10-12 September 2021, Sydney, Australia
http://icsmge2021.org/7iygec

In September 2021, the global community of soil mechanics and geotechnical engineering practitioners will come together in Sydney, Australia for the 20th International Conference on Soil Mechanics and Geotechnical Engineering (ICSMGE). For

the 7th time, young geotechnical practitioners will have the opportunity to meet at their own dedicated Conference on the days immediately prior to the ICSMGE in a relaxed, friendly and supportive environment to share their research, ideas and experience, build international networks and discuss the challenges facing young geotechnical engineers in a rapidly changing world.

Our Conference will be held at the International Convention Centre in Darling Harbour, Sydney over the three days prior to the ICSMGE giving delegates the opportunity to remain in Sydney for the main Conference.

This Conference seeks to provide a relaxed and supportive environment for young geotechnical engineers to present at their first major Conference with all delegates given the opportunity to present. We will have a particular focus on sustainability and on issues facing young geotechnical professionals beyond 2021

Congress secretariat

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SYDNEY ICSMGE 2021 20th International Conference on Soil Mechanics and Geotechnical Engineering, 12-17 September 2021, Sydney, Australia, www.icsgme2021.org

International Conference on Textile Composites and Inflatable Structures (MEMBRANES 2021)
13-15 September 2021, Munich, Germany
https://congress.cimne.com/membranes2021/frontal/default.asp

The **tenth edition** of the conference on **Textile Composites and Inflatable Structures (STRUCTURAL MEMBRANES 2021)** will be organised on **13-15 September 2021 in Munich, Germany**. The previous conferences of these series were held in Barcelona (2003, 2007, 2011, 2015), Stuttgart (2005, 2009) and Munich (2013, 2017). The last edition of the Structural Membranes conference took place in Barcelona on October 2019, in conjunction with the conference commemorating the 60th anniversary of the Imternational Association for Shell and Space Structures (IASS).

The objectives of **Structural Membranes 2021** are to collect and disseminate state-of-the-art research and technology for design, analysis, construction and maintenance of textile and inflatable structures. The conference will address both the theoretical bases for structural analysis and the numerical algorithms necessary for efficient and robust computer implementation. A significant part of the conference will be devoted to discuss advances in new textile composites for applications in membrane and inflatable structures in the building and construction sectors, as well as in innovative design, construction and maintenance procedures.

Structural Membranes 2021 aims to be a forum for discussing recent progress and identifying future research directions in the field of textile composites and inflatable structures.

Structural Membranes 2021 will be supported by the IASS. It will also be a Thematic Conference of the European Community on Computational Methods in Applied Sciences (ECCOMAS) and a Special Interest Conference of the International Association for Computational Mechanics (IACM).

Conference Topics

- Design Methods
- Numerical Methods for Structural Analysis
- New Membrane Materials
- Testing Procedures
- Manufacturing
- Construction Methods
- Maintenance Techniques
- Energy Aspects
- Climate Impact
- Environmental Aspects
- Pressure Management
- Adaptivity

Applications: Membrane roofs and covers, sails, inflatable pavilions and buildings, airships, airspace structures, inflatable antennas, high altitude platforms, furniture, bio-membranes, textiles for clothes, etc.

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LATAM 2021 – IX Latin American Rock Mechanics Symposium Challenges in rock mechanics: towards a sustainable development of infrastructure, 20-22 September 2021, Asuncion, Paraguay, https://larms2021.com

GeoAfrica 2021 - 4th African Regional Conference on Geosynthetics Geosynthetics in Sustainable Infrastructures and Mega Projects, October 2021, Cairo, Egypt, https://geoafrica2021.org

Eurock 2022

Rock and Fracture Mechanics in Rock Engineering and Mining
13÷17 June 2022, Helsinki, Finland

Contact Person: Lauri Uotinen
E-mail: lauri.uotinen@aalto.fi

3rd European Conference on Earthquake Engineering and Seismology (3ECEES), 19-24 June 2022, Bucharest, Romania, https://3ecees.ro

UNSAT2022
8th International Conference on Unsaturated Soils
June or September 2022, Milos island, Greece

12 ICG

12th International Conference on Geosynthetics
September 18 – 22, 2022, Rome, Italy

15th ISRM

International Congress in Rock Mechanics
9÷14 October 2023, Salzburg, Austria

Contact Person: Prof. Wulf Schubert
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ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Advancements in Large Diameter TBM Tunneling

Over the past two decades soft ground and mixed face TBM tunnels have increased in diameter such that the term 'large diameter TBM tunnel' has become common usage. However, there is no actual definition of what constitutes 'large.' Therefore, in this article 'large' will refer to any tunnel of 30 ft, or greater, internal diameter.

Prior to the development of closed face TBM technologies large diameter soft ground tunnels were confined to favorable tunneling strata and constructed using compressed air. Examples include the Blackwall Tunnels (1897) under the Thames in the impermeable London Clay in London or the Hudson Tunnel (1927) and the Lincoln Tunnel (1938) in the United States. Many deaths occurred during the construction of these tunnels under difficult ground conditions. In 1997 the Tokyo Bay Aqualine Tunnel opened to traffic. This tunnel was 23 years in planning and 9 years in construction. It comprises twin two-lane 39-ft ID highway tunnels 9.6 km long. The tunnels were bored through soft alluvial soils by eight Kawasaki slurry 46-ft OD TBMs. The 23-year gestation of the project is in part due to the absence of a tunneling system capable of handling the ground conditions both safely and economically. This project represents one of the first major projects reliant on pressurized closed face TBM technology. Since this achievement, the appetite for large diameter tunneling in challenging ground conditions has grown.

Closed face pressurized TBMs that were developed specifically to operate in either loose non-cohesive soils below the groundwater table and soft clays are now commonly used to excavate through mixed face conditions of soil and rock, and full faces of rock.

The two principal types of closed face pressurized TBM, the slurry and earth pressure balance (EPB) have been joined by hybrid TBMs that can operate in either mode depending on ground conditions. However, the TBM diameter must be large enough to accommodate the two separate mucking systems, conveyor belts and the slurry circuit plus segment and other materials transport and ventilation ducting.

Lining Design

While for the most part the design methods and procedures for designing large diameter tunnels are the same for any other segmentally lined tunnels there are specific areas that require special attention. In particular the longitudinal behavior.

In soft and loose soils, shafts can comprise fixed points anchoring the floating tunnel structure. This fixity leads to the tunnel adopting a sagging and hogging profile. This action occurs irrespective of tunnel diameter but the larger the diameter the greater the consequences. These can include local overstress at the crown and invert in the circle joint as the rings attempt to conform to the profile by pivoting about either the crown or the invert. This overstress should not lead to a catastrophic failure but it can comprise sealing gaskets causing long-term maintenance issues. Either by creating seepage paths behind the gasket or reducing the compression force closing the gasket. In smaller diameter tunnels this can be mitigated by using a flexible joint between the segmental lining and the shaft wall. However, in large diameter tunnels this may not be sufficient and additional measures may be required to limit the longitudinal movement. This could be tensioned through bolts in the circle joint, to increase the longitudinal stiffness and limit deflection.

TM-CLKL: 58ft Dia Slurry TBM

Liang Tang Tunnel: 58ft Dia EPB TBM

Monitoring and Control of TBM Operating Parameters

The physical principles by which these TBMs operate are well understood. However, less well known is the essential role that the ancillary systems play. These include the PLC and SCADA systems that monitor, log and facilitate the control of the TBMs in the ground. The sheer volume of data that a TBM system generates is staggering and potentially bewildering. These systems can be divided in two principal functions. Those that monitor the 'health' of the TBM and those that monitor the performance of the TBM in the ground.

An example of the former is the continuous measurement of temperature of the various lubricants and other fluids in the main bearing and other moving parts. The latter include face pressure, flow volumes and density of the slurry in the slurry circuit to determine the volume of muck excavated with each TBM advance. Similarly, belt scales and laser systems determine the volume of muck excavated in an EPB TBM. The larger the TBM the more critical these measurements are in order to assess the ground behavior and minimize ground loss and potential settlement. It is becoming increasingly common to link the real time readings of ground movement instrumentation to the TBM PLC. This allows the measured 'bow wave' settlement to be used as a predictive tool to determine total settlement allowing the TBM operating parameters to be adjusted as the TBM advances.

Parallel Operations

Large diameter tunnels allow parallel operations to be under-

taken during construction unlike for smaller tunnels where these activities have to be undertaken in series after completion of each operation. On AECOM's Chong Ming South Tunnel a precast central deck element was placed immediately behind the TBM that provided materials access and formed part of the permanent road deck. The precast element was followed in turn by cast in place concrete works to complete the road deck. AECOM's Tuen Mun Chek Lap Kok Link (TM-CLKL) tunnel represented a significant progression with full width precast deck elements being placed behind the TBM and the overhead vent similarly formed of precast elements reducing cast in place work to a minimum.

TM-CLKL: Precast Deck Unit

Chong Ming South: Central Precast Deck Unit

TM-CLKL: Cross Passage Construction

Another innovation made possible by large diameter TBM construction is mechanized cross passage construction. This was carried out on TM-CLKL tunnel using a slurry microtunneling TBM with a pipe jacked lining.

Cutterhead Intervention

Tool replacement or cutterhead maintenance remains the most high-risk activity in the tunneling operation. It is possible to minimize the potential for unscheduled interventions by creating grouted blocks as safe havens in which cutterhead inspection and maintenance can be carried out in atmospheric conditions. In addition, various technologies exist to change cutting tools and clear blockages without the need for entry to the pressurized cutterhead.

On the two Herrenknecht slurry TBMs employed on the Chong Ming South tunnels access to a limited number of tools was provided via cutterhead spokes. These tools could be removed and replaced through a stuffing box system. Recent advancements in large diameter TBMs provide for disk cutters and cutting knives to be replaced atmospherically from the back of the cutterhead using guillotine type doors. Examples include the Istanbul Strait Crossing TBM and Bertha for the Alaskan Way Tunnel TBM.

Chong Ming South TBM: Person-Entry Through Cutter Head Spokes for Cutting Tool Changes

Chong Ming South: TBM in Recovery Shaft

TM-CLKL: TBMs in Recovery Shaft

In the case of the TM-CLKL Tunnel, remotely operated robotic technology was used to change cutting tools. A robotic device known as the JetSnake developed by OC Technologies and Bouygues on the Port of Miami Tunnel was used. This device incorporates a television camera, high pressure water jet and laser profiling device to measure disc cutter wear. This device, as the name suggests, is capable of controlled movement in three dimensions allowing it to access all parts of the cutter head. In addition to the JetSnake the TELEMACH disc cutter changing system was used on TM-CLKL and the 46-ft diameter EPB TBM for the Liang Tang (Lungshan) tunnel projects. This system comprises a patented disc cutter locking system known as 'Muquet' and a robotic arm. A typical disc cutter installation comprises 11 parts while Muquet comprises a single piece. This innovation allows the removal and replacement of a single disc cutter to be carried out in as little as 25 minutes.

While the technologies outlined above have been proven successful on large diameter TBMs of both the slurry and EPB type, the need for entry in to a hyperbaric atmosphere remains if only to recover and repair these tools in the event of a mechanical breakdown, or damage.

Another trend is tunneling at deeper depths. For example, the Chong Ming South Tunnel is located 200 ft below the Yangtze surface and similarly the Westerschelde Tunnel is at a similar depth below the Scheldt Estuary in the Netherlands. Hyperbaric interventions would have to be carried out at pressures of up to 8 bar on these projects. For the Westerschelde tunnel, modifications were required to the cutterhead approaching the deepest section of the tunnel. A compressed air intervention could not be carried out at 8 bar without exposing personnel to unacceptable safety hazards. Therefore, the saturation diving technique was employed. This comprises a team of divers living in a hyperbaric habitat and being transported to the TBM in a pressurized shuttle that docks with an airlock on the pressure bulkhead.

FAT /TBM Hyperbaric Shuttle Connecting Flange

TM-CLKL: Hyperbaric Shuttle

The divers breathe mixed gases throughout their stay in the habit on occasion working for months at a time before decompression. Decompression can take a number of days as the pressure is reduced in a series of calibrated steps until atmospheric pressure is achieved. Experience gained on the Westerschelde Tunnel informed the design and TBM technical specifications for the TM-CLKL where the technique was employed to supplement the robotic technologies also available to inspect and replace cutting tools. Similarly, for the Istanbul

Strait Crossing subjected to 12 bars of water pressure, four hyperbaric interventions were required.

Closing Remarks

TBM diameters have increased over the past decades to the point where planners and some others believe there is no limit to the diameter that can be built. While this may be true in the future the increase in TBM diameter is at, or approaching, the practical limit based upon current technologies. Therefore, careful consideration and caution must be applied in planning for even larger TBM tunnels.

(Bob Frew, AECOM's Subject Matter Expert of large diameter TBM tunnels, February 21, 2020, https://tunnelingonline.com/advancements-in-large-diameter-tbm-tunneling)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Seismic Isolation Systems

Animation of seismic protection systems – mageba pendulum bearing

https://www.youtube.com/watch?v=I1NWtVaTg7I&feature=share&fbclid=IwAR1BjLrrt3bIl-saauZVIQtG8WQlT-HkIBJZJ6nCxhor3Z6XF2lXNyOi4-k

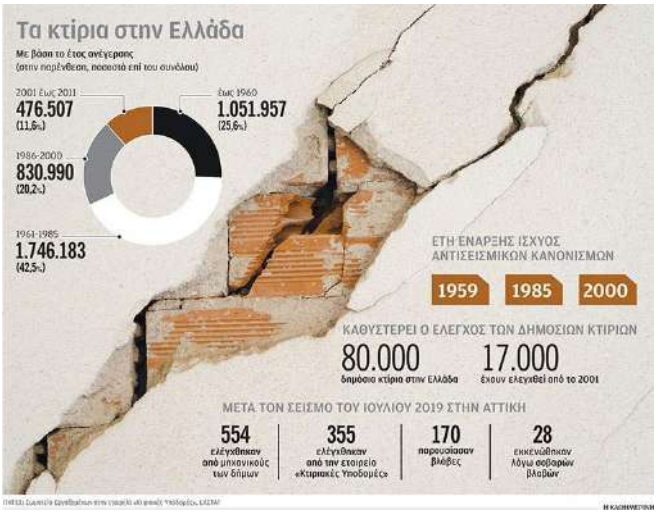
THK Seismic Isolation System Introduction

https://www.youtube.com/watch?v=7eO23oeXJlw

Seismic isolation system by Japan society of seismic isolation

https://www.youtube.com/watch?v=Fk_3zjTDKm4

Αντισεισμική θωράκιση όπως ενεργειακή αναβάθμιση



Η ανάγκη ενός μεγάλου προγράμματος αντισεισμικής θωράκισης των κτιρίων, δημόσιων και ιδιωτικών, έρχεται στο προσκήνιο, κάθε φορά που οι σεισμικές δονήσεις στη χώρα ή στη γειτονιά μας «ταρακουνούν» τον εφησυχασμό. Τα κτίρια στην Ελλάδα διαπερνώνται από μια μεγάλη αντίφαση: από τη μια όσα κτίστηκαν μετά το 1985 και ειδικά μετά το 2000 έχουν ανεγερθεί –εφόσον τηρήθηκαν οι όροι– με αξιόπιστους αντισεισμικούς κανονισμούς. Από την άλλη, το ποσοστό των κτιρίων αυτών δεν ξεπερνά το 1/3 των κατασκευών με οπλισμένο σκυρόδεμα (τσιμέντο) και είναι κάτω του 20% του συνόλου των κτιρίων της χώρας.

«Μόνο το 55% των κατασκευών στην Ελλάδα είναι από οπλισμένο σκυρόδεμα, τα υπόλοιπα φέρουν μόνο τοιχοποιία, κυρίως από πέτρα. Τα πέτρινα κτίρια δεν έχουν, προφανώς, ακολουθήσει κάποιον αντισεισμικό κανονισμό. Εάν υπολογίσουμε και το ποσοστό των κτιρίων από σκυρόδεμα που έχουν ανεγερθεί πριν από το 1959, όταν θεσπίστηκε ο πρώτος κανονισμός, βλέπουμε πως σχεδόν το 60% των κτιρίων της χώρας δεν έχει κτιστεί σύμφωνα με αντισεισμικές προδιαγραφές», λέει στην «Κ» ο κ. Κωνσταντίνος Σπυράκος, καθηγητής Αντισεισμικών Κατασκευών στη σχολή Πολιτικών Μηχανικών του ΕΜΠ. Δεν σημαίνει πως όλα αυτά τα κτίρια είναι επικίνδυνα (εξάλλου τα περισσότερα έχουν αντέξει σε σεισμούς), αλλά έχουν αποδειχθεί πιο ευάλωτα σε ισχυρές σεισμικές δονήσεις και καταπονούνται με το πέρασμα των ετών. «Είδαμε τις ζημιές στα πέτρινα κτίρια μετά τους σεισμούς στη Λέσβο, στη Λευκάδα, στην Αμφίκλεια. Επίσης, ευπαθή κτίρια υπάρχουν μεταξύ εκείνων με πυλωτές, τα οποία έχουν ανεγερθεί πριν από τη θέσπιση των ισχυρών αντισεισμικών κανονισμών», συμπληρώνει ο κ. Σπυράκος.

Ο αντισεισμικός οικοδομικός κανονισμός του 1985, μετά τους ισχυρούς σεισμούς σε Αθήνα και Θεσσαλονίκη, θεωρείται πως αναβάθμισε σημαντικά το επίπεδο προστασίας για τις οικοδομές της χώρας, ενώ το επόμενο βήμα έγινε το 2000 (μετά τον ισχυρό σεισμό στην Πάρνηθα) όπου υπήρξε ποιοτική αναβάθμιση της θωράκισης των κτιρίων. Όμως, τα κτίρια που ανεγέρθηκαν μεταξύ 1985-2000 είναι περίπου το 20% όσων διαθέτουν οπλισμένο σκυρόδεμα, ενώ μετά το 2000 κτίστηκε περίπου το 12% του συνόλου. Τι γίνεται με τα υπόλοιπα;

Δυστυχώς, υπάρχουν μεγάλα κενά στον έλεγχο της στατικής επάρκειας. Κατ' αρχάς στα δημόσια κτίρια, που συγκεντρώνουν σε καθημερινή βάση πλήθος κόσμου: νοσοκομεία, σχολεία, δημόσιες υπηρεσίες, πάνω από 80.000 κτίρια πανελλαδικά πολλά από τα οποία είναι μεγάλης ηλικίας. Το 2000 αποφασίστηκε ένα πρόγραμμα ελέγχου των δημόσιων κτιρίων. Σήμερα, σχεδόν 20 χρόνια μετά δεν έχουν ελεγχθεί πάνω από 17.000-18.000! Με τους ρυθμούς αυτούς απαιτούνται ακόμα... 60 χρόνια για να ολοκληρωθεί το πρόγραμμα. Κάπως απαλύνεται η εικόνα από το γεγονός πως τα κτίρια που έχουν ελεγχθεί είναι κυρίως εκείνα που συγκεντρώνουν περισσότερο κόσμο. Επίσης, πως οι πιο σεισμογενείς περιοχές, όπως τα Ιόνια, ή οι πιο πολυπληθείς (όπως η Αττική) έχουν προχωρήσει περισσότερο στους ελέγχους.

«Το πρόγραμμα ελέγχου των δημόσιων κτιρίων καθυστερεί λόγω της γραφειοκρατίας και κυρίως λόγω της έλλειψης προσωπικού. Ο έλεγχος των σχολείων, για παράδειγμα, είναι στην αρμοδιότητα της Τοπικής Αυτοδιοίκησης. Αλλά εκεί αναφέρονται μεγάλα κενά μηχανικών», σημειώνει ο κ. Σπυράκος.

«Η χώρα χρειάζεται ένα εκτεταμένο και ολοκληρωμένο πρόγραμμα προσεισμικού ελέγχου και αντισεισμικής προστασίας ιδιωτικών και δημοσίων κτιρίων, που να καλύπτει όμως όλα τα δομήματα: μνημεία, γέφυρες και τεχνικά έργα, φράγματα και όλες τις υποδομές. Το ΤΕΕ έχει συμβάλει με τα εθνικά προγράμματα ΑΝΤΥΚ και ΕΠΑΝΤΥΚ στην ενημέρωση και τεκμηρίωση προς τις εθνικές και δημοτικές αρχές. Χρειάζεται όμως και δράση», λέει στην «Κ» ο πρόεδρος του Τεχνικού Επιμελητηρίου Ελλάδος (ΤΕΕ) κ. Γιώργος Στασινός. «Προτείνουμε να προχωρήσει άμεσα ο έλεγχος όλων των δημοσίων κτιρίων με άμεσο πρωτοβάθμιο προσεισμικό έλεγχο δομικής τρωτότητας, καθώς έχει ελεγχθεί λιγότερο από το 25% των δημοσίων κτιρίων», αναφέρει.

Τα ιδιωτικά

Τι γίνεται όμως με τα ιδιωτικά κτίρια; «Υπάρχουν τα κτίρια συνάθροισης κοινού, όπως οι κινηματογράφοι, τα θέατρα, τα ξενοδοχεία με συνεδριακές αίθουσες κ.λπ., τα οποία πρέπει να ιεραρχηθούν», υπογραμμίζει ο κ. Σπυράκος. «Από εκεί και πέρα χρειάζεται ιδιαίτερη πρόνοια για την αντισεισμική ενίσχυση των παλιότερων κτιρίων. Δεν έχει νόημα, για παράδειγμα, να γίνεται ενεργειακή αναβάθμιση κτιρίων χωρίς να έχει ελεγχθεί η στατικότητά τους», συμπληρώνει ο καθηγητής του ΕΜΠ.

Πώς θα γίνει; «Χρειάζονται κίνητρα οικονομικά. Στη γειτονική Ιταλία εφαρμόζεται το πρόγραμμα casa sicura (σίγουρο σπίτι) όπου δίνονται φοροαπαλλαγές για τους ιδιοκτήτες οι οποίοι

προχωρούν σε αντισεισμική ενίσχυση των κατοικιών τους, από 90.000 ευρώ για κάθε ιδιοκτησία, απαλλαγή που μπορεί να ανεβεί ανάλογα με την έκταση των επεμβάσεων. Το κέρδος είναι πολλαπλό: ασφάλεια των κατασκευών και αναζωογόνηση της οικονομίας. Η αντισεισμική τεχνολογία έχει αναπτυχθεί πολύ και το κόστος των παρεμβάσεων έχει πέσει. Σε κάθε περίπτωση είναι πολύ μικρότερο της ζημιάς που μπορεί να προκληθεί». Ο κ. Σπυράκος σημειώνει πως χρειάζονται επιπλέον μέτρα βοήθειας για τους ιδιοκτήτες διατηρητέων κτιρίων, καθώς οι αναγκαίες παρεμβάσεις είναι πιο δαπανηρές με αποτέλεσμα να οδηγούνται στην εγκατάλειψη.

«Τα ιδιωτικά κτίρια μπορούν να ελεγχθούν σε ένα βάθος χρόνου, παράλληλα με την καθιέρωση της Ηλεκτρονικής Ταυτότητας Κτιρίου και μάλιστα να δοθεί προτεραιότητα σε όσα έχουν χτιστεί προ του 1985. Το ίδιο θα συμβεί, εκτιμώ, και με τις υποδομές, μέσα από τη δημιουργία του Εθνικού Μητρώου Υποδομών. Παράλληλα, να δοθούν μόνιμα οικονομικά κίνητρα για την ενίσχυση ιδιωτικών κτιρίων που διατρέχουν κίνδυνο βλαβών από σεισμό, για παράδειγμα με έκπτωση φόρου όχι μόνο για τις εργασίες, που ήδη προβλέφθηκε, αλλά και για τα αναγκαία υλικά. Και πρέπει επίσης να συνδεθούν τα προγράμματα σεισμικής ενίσχυσης με εκείνα της ενεργειακής εξοικονόμησης», προτείνει από την πλευρά του ο κ. Στασινός. «Δεν μπορεί να έχουμε πολίτες δύο κατηγοριών: αυτούς που ζουν σε παλαιά κτίρια τα οποία χτίστηκαν χωρίς αντισεισμικό κανονισμό και αυτούς που έχουν σύγχρονα και κατά το δυνατόν ασφαλή κτίρια», υπογραμμίζει ο πρόεδρος του ΤΕΕ.

Ο σεισμός και οι διευθυντές!

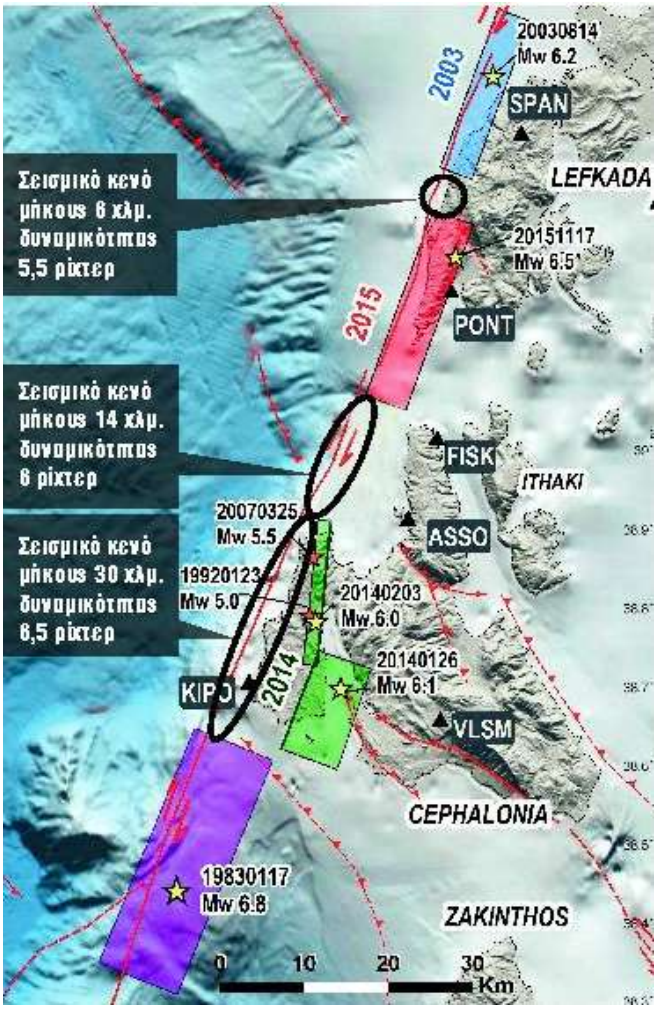
Αποκαλυπτικά της κατάστασης που επικρατεί στους δήμους, σχετικά με την αντισεισμική προστασία των σχολικών κτιρίων, είναι όσα έγιναν μετά τον σεισμό των 5,1 Ρίχτερ της 19ης Ιουλίου 2019 στην Αττική (Μαγούλα). Τότε οι περισσότεροι δήμοι απευθύνθηκαν στην εταιρεία Κτιριακές Υποδομές (ΚΤΥΠ), όπου ανήκουν τα κτίρια του Δημοσίου και ζήτησαν συνεργεία μηχανικών, δηλώνοντας αδυναμία να πραγματοποιήσουν ελέγχους! Καθώς ούτε και η εταιρεία ΚΤΥΠ μπορούσε να ανταποκριθεί συνολικά (αποδυναμωμένη από μηχανικούς), ζητήθηκε από τους... διευθυντές των σχολείων να κάνουν ένα πρώτο οπτικό έλεγχο! Εάν ο διευθυντής έβλεπε (και μπορούσε να καταλάβει...) πρόβλημα, τότε ειδοποιούσε τους μηχανικούς! Σύμφωνα με τα στοιχεία που δημοσίευσαν οι εργαζόμενοι στην «Κτιριακές Υποδομές» ελέγχθηκαν 909 σχολικά κτίρια-συγκροτήματα (355 από τις ΚΤΥΠ, τα υπόλοιπα από τους δήμους) από τις 3.080 του συνόλου. Απ' όσα έλεγξαν κλιμάκια των ΚΤΥΠ βρέθηκαν 164 με βλάβες, ενώ για 28 κρίθηκε απαραίτητη η εκκένωσή τους. Όχι και τόσο άτρωτα...

(Γιάννης Ελαφρός / Η ΚΑΘΗΜΕΡΙΝΗ, 03.02.2020,
https://www.kathimerini.gr/1062987/article/epikairothta/ellada/antiseismikh-8wrakish-opws-energeiakh-anava8mish)

Ποια είναι τα «σεισμικά» κενά του Ιονίου που δεν έχουν ακόμη διαρραγεί

Σεισμός : Ρήγματα που προβλέπεται να δώσουν ισχυρές δονήσεις έντασης 5,5 – 6,5 ρίχτερ μέσα στα επόμενα 20 χρόνια εντόπισαν οι επιστήμονες σε Λευκάδα και Κεφαλονιά – Παραμένουν «σιωπηλά» τα τελευταία 37 χρόνια.

Μια εκκρεμότητα... αιώνων έκλεισε, σύμφωνα με τους επιστήμονες, ο ισχυρός σεισμός που σκόρπισε τον θάνατο στο Ελαζίγκ της Τουρκίας την προηγούμενη εβδομάδα: Το σημείο στο οποίο προκλήθηκε η δόνηση των 6,8 ρίχτερ το βράδυ της 24ης Ιανουαρίου ήταν το μοναδικό κομμάτι του ρήγματος της Ανατολικής Ανατολίας – ενός ρήγματος με συνολικό μήκος 470 χλμ. – που δεν είχε διαρραγεί ποτέ στην ιστορία. Ήταν ένα «σεισμικό κενό», όπως αποκαλούν το φαινόμενο οι ερευνητές, που όλοι ανέμεναν να «σπάσει» παράγοντας έναν ισχυρό σεισμό· όμως κανείς δεν γνώριζε το πότε...



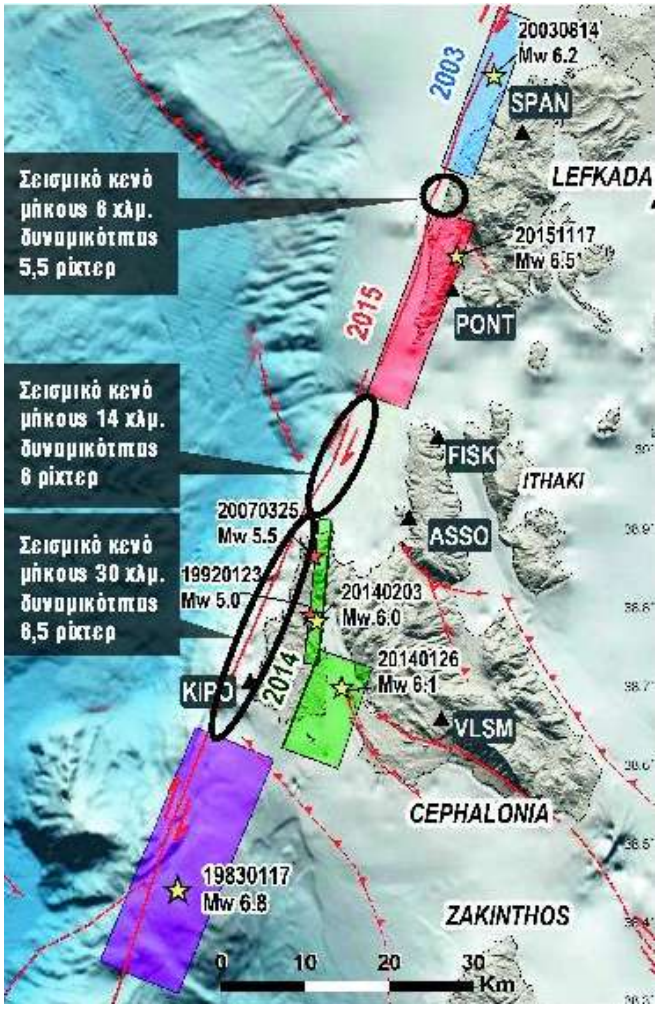
Αντίστοιχα «σεισμικά κενά» εντοπίζονται και στην Ελλάδα και συγκεκριμένα στο Κεντρικό Ιόνιο, τα οποία παραμένουν «σιωπηλά» τα τελευταία τουλάχιστον 37 χρόνια παρά την έντονη σεισμική δραστηριότητα που έχει σημειωθεί στην περιοχή πέριξ αυτών. Τα σεισμικά κενά του Ιονίου χαρτογραφήθηκαν πλήρως το 2016 σε μελέτη που πραγματοποιήθηκε με τη χρήση δεδομένων διαστημικής γεωδαισίας και η οποία δημοσιεύτηκε σε διεθνή επιστημονικά περιοδικά, με επικεφαλής τον σεισμολόγο και διευθυντή Ερευνών του Γεωδυναμικού Ινστιτούτου δρα Αθανάσιο Γκανά.

«Κλειδί για προβλέψεις»

«Ο σεισμός στο Ελαζίγκ έκλεισε το σεισμικό κενό που υπήρχε κατά μήκος του ρήγματος της Ανατολικής Ανατολίας», εξηγεί στα «ΝΕΑ» ο δρ Γκανάς. «Το συγκεκριμένο ρήγμα αποτελείται από επτά κομμάτια, το καθένα με μήκος από 50 έως και 100 χιλιόμετρα, τα οποία «σπάνε» ανεξάρτητα και παράγουν σεισμούς μεγέθους 6 έως 7,5 ρίχτερ. Ο προηγούμενος μεγάλος σεισμός είχε σημειωθεί στην περιοχή Μπινγκόλ – περί τα 100 χιλιόμετρα ανατολικότερα – το 2010, με μέγεθος 6,1 ρίχτερ. Το κομμάτι του ρήγματος που έσπασε νότια του Ελαζίγκ στις 24 Ιανουαρίου με μέγεθος 6,8 ρίχτερ ήταν το μοναδικό για το οποίο δεν είχαμε ιστορικές καταγραφές άρα αποτελούσε «σεισμικό κενό».

Το γεγονός αυτό επιβεβαιώνει τη θεωρία του «σεισμικού κενού» και αποδεικνύει ότι αυτή συνιστά ένα κλειδί για την πρό-

βλεψη των μελλοντικών διαρρήξεων πάνω σε μεγάλα ρήγματα του πλανήτη εφόσον είναι γνωστό το σεισμικό ιστορικό τους, το οποίο μπορεί να αποκτηθεί με συνδυασμό γεωλογικών και σεισμολογικών μεθόδων», προσθέτει.



Με τον ίδιο τρόπο οι επιστήμονες κατόρθωσαν να εντοπίσουν τα σημεία στα οποία αναμένεται να εκδηλωθούν οι επόμενοι μεγάλοι σεισμοί του Κεντρικού Ιονίου. Πρόκειται για τρία κομμάτια μεγάλων ρηγμάτων τα οποία δεν «έσπασαν» κατά τη διάρκεια πρόσφατων ισχυρών σεισμών: Το πρώτο «σεισμικό κενό», μήκους 6 χιλιομέτρων, εντοπίζεται κατά μήκος της δυτικής ακτής της Λευκάδας, το δεύτερο, μήκους 14 χιλιομέτρων, βρίσκεται βορειοδυτικά της Κεφαλονιάς και το τρίτο με μήκος 30 χιλιόμετρα κατεγράφη στις δυτικές ακτές του νησιού. Σύμφωνα με τους ειδικούς, τα σημεία αυτά μπορεί να δώσουν σεισμούς έντασης από 5,5 έως 6,5 ρίχτερ και παρότι δεν είναι εύκολο να προβλεφθεί χρονικά η συμπεριφορά τους αναμένεται ότι τα συγκεκριμένα σημεία θα διαρραγούν εντός των επόμενων 20 ετών.

Η χαρτογράφηση

«Επειδή για το Ιόνιο δεν έχουμε παλαιοσεισμολογικά δεδομένα, το κενό αυτό αναπλήρωσαν τα δεδομένα διαστημικής γαιωδεσίας», λέει ο δρ Γκανάς περιγράφοντας τη διαδικασία που ακολούθησε ο ίδιος και η επιστημονική του ομάδα για την περίπτωση του Κεντρικού Ιονίου. «Αξιοποιώντας αυτά τα δεδομένα, χαρτογραφήσαμε λεπτομερώς την εδαφική παραμόρφωση που είχε προκύψει στην περιοχή από τέσσερις παλαιότερους ισχυρούς σεισμούς», λέει. Ήταν οι σεισμικές δονήσεις της 14ης Αυγούστου 2003 που είχε πλήξει τη Λευκάδα με 6,2 ρίχτερ, οι σεισμοί μεγέθους 6,1 και 6 ρίχτερ που εκδηλώθηκαν στην Κεφαλονιά τον Ιανουάριο και τον Φεβρουάριο του 2014 και η δόνηση των 6,5 ρίχτερ που σημειώθηκε στη Λευκάδα τον Νοέμβριο του 2015. Πριν από αυτούς, το 1983 στη θαλάσσια περιοχή νοτιοδυτικά της Κεφαλονιάς είχε προκληθεί σεισμός 6,8 ρίχτερ. Όλοι ήταν φαινόμενα μεγάλης ισχύος που είχαν προκαλέσει απώλειες ανθρώπινων ζωών, υλικές καταστροφές και εδαφικές μετατοπίσεις έως και 36 εκατοστών.

Παρ' όλ' αυτά τα ακριβή όρια των ρηγμάτων που είχαν προκαλέσει αυτούς τους σεισμούς, δεν ήταν γνωστά καθώς δεν είχαν επιφανειακές εκδηλώσεις. Μέσω των δορυφόρων αποκαλύφθηκαν τα όριά τους και στη συνέχεια εντοπίστηκαν τα «σεισμικά κενά» μεταξύ των διαδοχικών διαρρήξεων. Αυτά τα κενά οι σεισμολόγοι θεωρούν ότι θα «γεμίσουν» με διαρρήξεις, και συνεπακόλουθα σεισμούς, τα επόμενα χρόνια. Σημειώνεται ότι η περιοδικότητα των σεισμών στο Κεντρικό Ιόνιο είναι περίπου 40 έτη. Για τον εντοπισμό των «σεισμικών κενών» οι επιστήμονες αξιοποιούν τα επαληθευμένα επιστημονικά δεδομένα καθώς για σεισμούς γνωστούς από ιστορικές αναφορές δεν είναι δυνατός ο ακριβής προσδιορισμός του επικέντρου.

Μετατόπιση εδάφους από τον σεισμό της Τουρκίας

Εντυπωσιακή μετατόπιση του εδάφους προκάλεσε ο σεισμός της Τουρκίας στις 24 Ιανουαρίου του 2020. Σύμφωνα με μετρήσεις ερευνητών του Γεωδυναμικού Ινστιτούτου της Αθήνας, το έδαφος εκατέρωθεν του ρήγματος μετατοπίστηκε κατά… 70 εκατοστά ενώ το συνολικό μήκος της διάρρηξης ανέρχεται σε 40 χιλιόμετρα. Η συνολική έκταση της παραμόρφωσης ανέρχεται σε 350 τετραγωνικά χιλιόμετρα, έκταση στην οποία εντοπίζονται και μικρότερες μετατοπίσεις. Τα συμπεράσματα προέκυψαν από ανάλυση δορυφορικών δεδομένων που πραγματοποίησαν οι ερευνητές του Γεωδυναμικού Ινστιτούτου Σωτήρης Βαλκανιώτης, Αθανάσιος Γκανάς και Βαρβάρα Τσιρώνη.

(ToBHMA Team, 03.02.2020,

https://www.tovima.gr/2020/02/03/science/poia-einai-ta-seismika-kena-tou-ioniou-pou-den-exoun-akomi-diarragei)

Σεισμοί στην Ελλάδα: Από την αρχαιότητα έως σήμερα

Την έντονη σεισμική δραστηριότητα των τελευταίων ημερών αναλύει ο σεισμολόγος Γεράσιμος Παπαδόπουλος κάνοντας ιστορική αναδρομή σε αντίστοιχες αναφορές από τον εποχή του Ηροδότου μέχρι σήμερα

Σύμφωνα με τον επιστημονικό συνεργάτη της ΕΕ και της UNESCO «Το θέμα με τη χώρα μας είναι ότι η σεισμικότητα

έχει μεγάλη πολυπλοκότητα και δεν συνδέεται μόνο με έναν τύπο ρηγμάτων, αλλά με όλους τους κύριους τύπους ρηγμάτων που συναντάμε στον πλανήτη».

«Οι μεγάλοι και μικροί σεισμοί των τελευταίων ημερών προκαλούνται από σπασίματα της λιθόσφαιρας σε ολόκληρο τον ελλαδικό χώρο. Οι περισσότεροι από αυτούς είναι επιφανειακοί, δηλαδή έχουν εστία σε βάθος έως και 50 χιλιομέτρων. Αλλά στο νότιο Αιγαίο γίνονται σεισμοί και ενδιάμεσου βάθους με εστίες που φθάνουν τα 200 χιλιόμετρα. Αυτό οφείλεται στο ότι η αφρικανική λιθοσφαιρική πλάκα κάμπτεται κατά μήκος του ελληνικού τόξου και βυθίζεται στο εσωτερικό της Γης. Εξαιτίας της ίδιας διαδικασίας, σε βάθος περίπου 150 χιλιομέτρων παράγεται θερμό μάγμα που ανεβαίνει προς την επιφάνεια και σχηματίζει το ηφαιστειακό τόξο του νότιου Αιγαίου με κύρια ηφαιστειακά κέντρα στη Σαντορίνη και τη Νίσυρο, που θεωρούνται ενεργά ηφαίστεια. Στα Μέθανα το ηφαίστειο είναι μάλλον ενεργό, ενώ στη Μήλο και στην Κω, τα ηφαίστεια είναι ανενεργά πλέον. Σε όλα τα ηφαιστειακά κέντρα, όμως, παράγονται κατά καιρούς και σεισμοί ηφαιστειακής προέλευσης» εξηγεί στο ΑΠΕ-ΜΠΕ ο δρ Γεράσιμος Παπαδόπουλος, σεισμολόγος, επιστημονικός συνεργάτης της ΕΕ και της UNESCO.

«Η ιστορία των σεισμών στην Ελλάδα πηγαίνει πολύ βαθιά στο παρελθόν. Υπάρχουν γραπτές πηγές που ξεκινούν από τον Ηρόδοτο, τον πατέρα της ιστορίας, φθάνουν στην κλασική αρχαιότητα (π.χ. Θουκυδίδης) και μετά, στους ελληνιστικούς και βυζαντινούς χρόνους, στην αραβοκρατία και την ενετοκρατία, στην οθωμανική εποχή και καταλήγουν στα νεότερα χρόνια, οπότε άρχισε η καταγραφή των σεισμών γύρω στα 1900. Αλλά και πριν, έχουμε μαρτυρίες για ισχυρούς σεισμούς, από τα ίχνη που άφησαν πίσω τους στο έδαφος και σε αρχαιολογικούς χώρους» σημειώνει στο ΑΠΕ-ΜΠΕ ο κ. Παπαδόπουλος, και προσθέτει: «Το θέμα με τη χώρα μας δεν είναι μόνο ότι γίνονται πολλοί σεισμοί, ούτε το ότι έχει την υψηλότερη σεισμικότητα σε ολόκληρη τη δυτική Ευρασία, δηλαδή από τα Ουράλια ίσαμε τον Ατλαντικό και από την Αφρική ως το Βόρειο Πόλο. Είναι και το ότι η σεισμικότητα στην Ελλάδα έχει μεγάλη πολυπλοκότητα και δεν συνδέεται μόνο με έναν τύπο ρηγμάτων, αλλά με όλους τους κύριους τύπους ρηγμάτων που συναντάμε στον πλανήτη. Η λιθόσφαιρα στη γεωγραφική περιοχή της χώρας μας και τις γύρω περιοχές είναι κυριολεκτικά κατακερματισμένη για τον λόγο ότι η περιοχή αυτή συνθλίβεται ανάμεσα στην αφρικανική πλάκα που κινείται προς τα ΒΑ και την ευρασιατική που κινείται προς τα ΝΔ, με μία σχετική μεταξύ τους μετακίνηση που φθάνει τα 6 εκατοστά ετησίως κατά μήκος του ελληνικού τόξου».

Το ελληνικό τόξο εκτείνεται από τα νησιά του Ιονίου, περνά στα νότια της Πελοποννήσου και μέσω της Κρήτης και της Καρπάθου καταλήγει στη Ρόδο και τη νοτιοδυτική Τουρκία. Ταυτόχρονα, η μικρή λιθοσφαιρική πλάκα της Ανατολίας, πρακτικά η γεωγραφική περιοχή της Τουρκίας, μετακινείται επίσης προς τα δυτικά και τα νοτιοδυτικά, συμπληρώνοντας το πεδίο των δυνάμεων που ασκούνται στη λιθόσφαιρα της Ελλάδας. Εν ολίγοις και αν η δραστηριότητα των λιθοσφαιρικών πλακών συνεχιστεί με τον ίδιο ή και ταχύτερο ρυθμό, οι χάρτες του μέλλοντος θα απεικονίζουν την Ελλάδα αγκαλιά με την Τουρκία. Ωστόσο η διαμόρφωση της στεριάς στον πλανήτη είναι υπόθεση παλιά και διαρκής. Το θέμα είναι τι γίνεται κατά τη διάρκειά της…

«Το αποτέλεσμα αυτής της κινητικότητας στη λιθόσφαιρα της Γης είναι η πολύ υψηλή σεισμικότητα που στατιστικά εκφράζεται στην Ελλάδα με έναν σεισμό μεγέθους 6 βαθμών της κλίμακας Ρίχτερ, ή μεγαλύτερο, περίπου κάθε χρόνο» σημειώνει ο κ. Παπαδόπουλος και διευκρινίζει: «Η συχνότητα εμφάνισης, όμως, των σεισμών είναι τόσο μεγαλύτερη όσο μικρότερο είναι το μέγεθος. Και αντίστροφα. Οι μεγάλοι σεισμοί είναι πιο σπάνιοι. Για παράδειγμα, οι σεισμοί μεγέθους 7 R επαναλαμβάνονται περίπου κάθε 10-12 χρόνια και οι ακόμη μεγαλύτεροι ακόμη πιο αραιά. Ο τελευταίος 7άρης, για την ακρίβεια 6,9 R, που είχαμε στη χώρα μας, ήταν στις 24 Μαΐου του 2014 στο βόρειο Αιγαίο. Εσείς, ο κόσμος δεν τον θυμάστε, επειδή δεν προκάλεσε καταστροφές. Αλλά ήταν ένας ισχυρός σεισμός στο πλαίσιο των αναμενόμενων».

Για, δε, τη σεισμική δραστηριότητα σε παγκόσμιο επίπεδο, ο κ. Παπαδόπουλος σημειώνει ότι κάθε χρόνο γίνονται από 15 έως 18 σεισμοί των 7 R και άνω! Και αν παρατηρηθεί κάτι περισσότερο σε αυτή τη συχνότητα, τότε δεν είναι τυχαίο.

Το ιστορικό των σεισμών στην Ελλάδα

Ο μεγαλύτερος σεισμός, που έχει καταγραφεί στην Ελλάδα είχε μέγεθος περίπου 8,5 R και σημειώθηκε στις 21 Ιουλίου του 365 μ.Χ. στη δυτική Κρήτη, όπου η παράκτια ζώνη ανασηκώθηκε κατά 6,5 μέτρα! Ταυτόχρονα, ένα θηριώδες τσουνάμι κατέκλυσε ολόκληρη τη λεκάνη της ανατολικής Μεσογείου. Επανάληψη του φαινομένου καταγράφηκε στις 8 Αυγούστου του 1303, με τη διαφορά ότι αυτή τη φορά ο σεισμός έγινε στην ανατολική πλευρά της Κρήτης.

Ο αμέσως επόμενος σε μέγεθος σεισμός καταγράφεται στις 12 Οκτωβρίου του 1856 με επίκεντρο στη θαλάσσια περιοχή ανάμεσα στην Κρήτη και τη Ρόδο και έχει μέγεθος 8,2 βαθμούς της κλίμακας Ρίχτερ. Ο σεισμός εξαφανίζει επτά χωριά στην Κρήτη και αφήνει πίσω του σε Κρήτη, Ρόδο, Κάρπαθο, Κάσο, Σύμη, Καστελόριζο, Αμοργό και Κύπρο 618 νεκρούς, 638 τραυματίες και περί τα 17.000 σπίτια κατεστραμμένα ή με σοβαρές ζημιές.

Αλλά πλούσιος σε σεισμική δραστηριότητα είναι και όλος ο 20ος αι., στη διάρκεια του οποίου έχουν σημειωθεί ανά την Ελλάδα, σύμφωνα με το αρχείο του Αστεροσκοπείου Αθηνών, 37 φονικοί σεισμοί μεγέθους από 6 έως και 8 βαθμών της κλίμακας Ρίχτερ και αμέτρητοι μικρότεροι. Τα ισχυρότερα χτυπήματα του Εγκέλαδου καταγράφονται στις 11 Αυγούστου του 1903 και στις 26 Ιουνίου του 1926 με 7,2 R και 8 R στα Κύθηρα και τη Ρόδο αντίστοιχα. Συγκριτικά με τις φονικές συνέπειες των κατοπινών σεισμών, δεν φαίνονται δραματικοί, δεδομένου ότι 14 ήταν οι νεκροί στα Κύθηρα και 12 στη Ρόδο. Ωστόσο, αν αναλογιστεί κανείς τον αριθμό των σπιτιών και των κατοίκων των νησιών εκείνης της εποχής, οι αριθμοί ασφαλώς δεν είναι αμελητέοι. «Η καταστροφικότητα ενός σεισμού δεν εξαρτάται μόνο από το μέγεθός του. Πρέπει να συντρέχουν ταυτόχρονα πολλοί παράγοντες. Το μέγεθος, η δομή του εδάφους, τα ποιοτικά χαρακτηριστικά των κατοικιών, ο χρόνος και η διάρκεια της δόνησης κ.α.» εξηγεί ο κ. Παπαδόπουλος.

Πάντως, ο φονικότερος σεισμός του προηγούμενου αιώνα χτύπησε στις 12 Αυγούστου του 1953 το νησιωτικό σύμπλεγμα Κεφαλονιά-Ζάκυνθος-Ιθάκη, όπου καταγράφηκαν συνολικά 455 νεκροί, 21 αγνοούμενοι και 2.412 τραυματίες. Ενδεικτικό της σφοδρότητας του σεισμού ήταν το γεγονός ότι από τα συνολικά 33.300 σπίτια των τριών νησιών, κρατήθηκαν όρθια κάτι παραπάνω από 5.000! Το πέρασμα του Εγκέλαδου άφησε γκρεμίδια ολόκληρη τη Ζάκυνθο, ολόκληρη την Ιθάκη, το Αργοστόλι και το Ληξούρι! Ενδεικτικά είναι τα πρωτοσέλιδα των εφημερίδων της εποχής… «Κεφαλληνία, Ζάκυνθος, Ιθάκη δεν υπάρχουν από της χθες» δημοσίευε σε πηχυαίο τίτλο στις 13 Αυγούστου 1953 η εφημερίδα «ΕΛΕΥΘΕΡΙΑ».

Εφικτή υπόθεση η πρόβλεψη των σεισμών

Ο σεισμός είναι η μόνη φυσική καταστροφή, που δεν «σηκώνει» ανθρώπινο δάκτυλο… Στις καταστροφικές συνέπειες των πλημμυρών ή των πυρκαγιών όλο και κάπου ανιχνεύεται ανθρώπινη εμπλοκή. Αλλά στον σεισμό; Πώς μπορεί κανείς να καταλάβει τι γίνεται στα… σώψυχα του πλανήτη;

Ο δρ Παπαδόπουλος εξηγεί στο ΑΠΕ-ΜΠΕ ότι, πράγματι, μία βραχυπρόθεσμη πρόβλεψη ακούγεται ανέφικτη… «Η σεισμολογία είναι ακριβώς το αντίθετο της μετεωρολογίας. Η δεύτερη, καταγράφοντας ορατά φαινόμενα μπορεί να προβλέψει για μερικές μέρες, αλλά όχι για περισσότερο χρόνο. Όταν, όμως, έχεις να κάνεις με ό,τι συμβαίνει στο εσωτερικό της γης,

άρα δεν το βλέπεις, καταγράφεις και μελετάς τις κινήσεις και υπολογίζεις για το βάθος του χρόνου. Ως εκ τούτου, η υπόθεση «βραχυπρόθεσμη πρόβλεψη» ακούγεται ουτοπική και η ερώτηση αυτονόητη… «Μα, τώρα, δρ Παπαδόπουλε, πιστεύετε πραγματικά ότι θα καταφέρουμε κάποτε να προβλέπουμε τους σεισμούς;». Αλλά η απάντηση είναι κάθετη! «Πέραν πάσης αμφιβολίας»!

-Πώς, δηλαδή;

«Με την έρευνα και την παρατήρηση. Όταν παρακολουθείς σοβαρά και συστηματικά μία περιοχή με πλούσια σεισμική δραστηριότητα, μπορείς να προβλέψεις τον μεγάλο σεισμό, καταγράφοντας την προσεισμική του ακολουθία. Σε αυτή τη μελέτη συγκλίνει και η επιστημονική έρευνα παγκοσμίως».

-Και πώς γνωρίζει ένας επιστήμονας ότι ένας από τους προσεισμούς δεν είναι ο κύριος;

«Οι προσεισμοί έχουν τα εξής τρία χαρακτηριστικά: χωροταξικά καταγράφονται πολύ κοντά ο ένας στον άλλο, η χρονική εξέλιξή τους βαίνει αυξανόμενη, δηλαδή πυκνώνουν προς τη μεγάλη δόνηση και τέλος, όσο πλησιάζουμε στον κύριο σεισμό, τόσο ανεβαίνει το μέγεθος του προσεισμού. Ώσπου γίνεται ο μεγάλος και το μέγεθος πια των δονήσεων που ακολουθούν, των μετασεισμών, βαίνει μειούμενο».

-Αυτό που περιγράφετε μοιάζει με τους πόνους της γέννας…

«Αυτό είναι. Σαν γέννα. Ή αν θέλετε, σαν τα μνημόνια που έπληξαν τη χώρα μας. Ξεκινήσαμε κάπως χαλαρά και όσο πλησιάζαμε προς την κορύφωση, τόσο έσφιγγε ο κλοιός…».

Κι όταν μία φτωχή χώρα με πλούσια σεισμική δραστηριότητα δεν έχει «καύσιμο» να ρίξει στην έρευνα, τι γίνεται; «Ακούστε. Κάποτε πρέπει να σταματήσουμε να γκρινιάζουμε. Στην Ελλάδα, που 40 χρόνια τώρα είναι πλήρες μέλος της ΕΕ, έρευνα γίνεται. Υπάρχουν ευρωπαϊκά κονδύλια, που διεκδικούν πολλοί επιστήμονες από διάφορες χώρες, και τα οποία για να εγκριθούν υπέρ σου, θα πρέπει να ανήκεις στους άριστους. Κι εμείς, είμαστε στους άριστους! Αλλά και στο εσωτερικό της χώρας μέσα στην κρίση, στο διάστημα 2016-19 το κονδύλι για την έρευνα αυξήθηκε σε 1% του ΑΕΠ, βέβαια λιγότερο κι από το μισό του μέσου όρου της ΕΕ, που είναι 2,2-2,3%. Ωστόσο, αυξήθηκε κι αυτό έγινε επειδή ο τότε αν. υπουργός Παιδείας, ο κ. Φωτάκης, προερχόταν ακριβώς από τον τομέα της έρευνας» λέει ο κ. Παπαδόπουλος.

Όταν δεν μπορείς να αποτρέψεις μια καταστροφή, ο μόνος τρόπος για να επιβιώσεις είναι να εκπαιδευτείς στο πώς θα την αντιμετωπίσεις… Κάποτε, όταν οι άνθρωποι ήταν ανυποψίαστοι για τα… τεκταινόμενα στο εσωτερικό της Γης, σεισμοί της τάξεως των 5 ή 5,5 R, λειτουργούσαν όπως οι παράπλευρες απώλειες των πολέμων: Άμαχοι νεκροί… Αλλά η ζωή εξελίσσεται και η επιστήμη τρέχει… «Είναι αδύνατο να αποφύγουμε τους σεισμούς. Μπορούμε όμως να μάθουμε να τους αντιμετωπίζουμε» τονίζει ο κ. Παπαδόπουλος και διευκρινίζει: «Να βάλουμε στη ζωή μας την εκπαίδευση και κανονισμούς που να τηρούνται».

Πηγή: ΑΠΕ-ΜΠΕ

(in.gr, 9 Φεβρουαρίου 2020, https://www.in.gr/2020/02/09/greece/seismoi-stin-ellada-apo-tin-arxaiotita-eos-simera)

How earthquakes deform gravity

New algorithm raises hope for innovative earthquake early warning systems

Summary: Researchers have developed an algorithm that for the first time can describe a gravitational signal caused by earthquakes with high accuracy. Tests with data from the 2011 earthquake near Fukushima show that the procedure could help to improve earthquake early warning systems in the future.

Lightning -- one, two, three -- and thunder. For centuries, people have estimated the distance of a thunderstorm from the time between lightning and thunder. The greater the time gap between the two signals, the further away the observer is from the location of the lightning. This is because lightning propagates at the speed of light with almost no time delay, while thunder propagates at the much slower speed of sound of around 340 metres per second.

Earthquakes also send out signals that propagate at the speed of light (300,000 kilometers per second) and can be recorded long before the relatively slow seismic waves (about 8 kilometers per second). However, the signals that travel at the speed of light are not lightning bolts, but sudden changes in gravity caused by a shift in the earth's internal mass. Only recently, these so-called PEGS signals (PEGS = Prompt elasto-gravity signals) were detected by seismic measurements. With the help of these signals, it might be possible to detect an earthquake very early before the arrival of the destructive earthquake or tsunami waves.

However, the gravitational effect of this phenomenon is very small. It amounts to less than one billionth of the earth's gravity. Therefore, PEGS signals could only be recorded for the strongest earthquakes. In addition, the process of their generation is complex: they are not only generated directly at the source of the earthquake, but also continuously as the earthquake waves propagate through the earth's interior.

Until now, there has been no direct and exact method to reliably simulate the generation of PEGS signals in the computer. The algorithm now proposed by the GFZ researchers around Rongjiang Wang can calculate PEGS signals with high accuracy and without much effort for the first time. The researchers were also able to show that the signals allow conclusions to be drawn about the strength, duration and mechanism of very large earthquakes. The study was published in the journal *Earth and Planetary Science Letters*.

An earthquake shifts the rock slabs in the earth's interior abruptly, and thus changes the mass distribution in the earth. In strong earthquakes, this displacement can amount to several meters. "Since the gravity that can be measured locally depends on the mass distribution in the vicinity of the measuring point, every earthquake generates a small but immediate change in gravity," says Rongjiang Wang, scientific coordinator of the new study.

However, every earthquake also generates waves in the earth itself, which in turn change the density of the rocks and thus the gravitation a little bit for a short time -- the earth's gravity oscillates to some extent in sync with the earthquake. Furthermore, this oscillating gravity produces a short-term force effect on the rock, which in turn triggers secondary seismic waves. Some of these gravitationally triggered secondary seismic waves can be observed even before the arrival of the primary seismic waves.

"We faced the problem of integrating these multiple interactions to make more accurate estimates and predictions about the strength of the signals," says Torsten Dahm, head of the section Physics of Earthquakes and Volcanoes at GFZ.

"Rongjiang Wang had the ingenious idea of adapting an algorithm we had developed earlier to the PEGS problem -- and succeeded."

"We first applied our new algorithm to the Tohoku quake off Japan in 2011, which was also the cause of the Fukushima tsunami," says Sebastian Heimann, program developer and data analyst at GFZ. "There, measurements on the strength of the PEGS signal were already available. The consistency was perfect. This gave us certainty for the prediction of other earthquakes and the potential of the signals for new applications."

In the future, by evaluating the changes in gravity many hundreds of kilometres away from the epicentre of an earthquake off the coast, this method could be used to determine, even during the earthquake itself, whether a strong earthquake is involved that could trigger a tsunami, according to the researchers. "However, there is still a long way to go," says Rongjiang Wang. "Today's measuring instruments are not yet sensitive enough, and the environmentally induced interference signals are too great for the PEGS signals to be directly integrated into a functioning tsunami early warning system."

Journal Reference:

- Shenjian Zhang, Rongjiang Wang, Torsten Dahm, Shiyong Zhou, Sebastian Heimann. **Prompt elasto-gravity signals (PEGS) and their potential use in modern seismology**. *Earth and Planetary Science Letters*, 2020; 536: 116150 DOI: 10.1016/j.epsl.2020.116150

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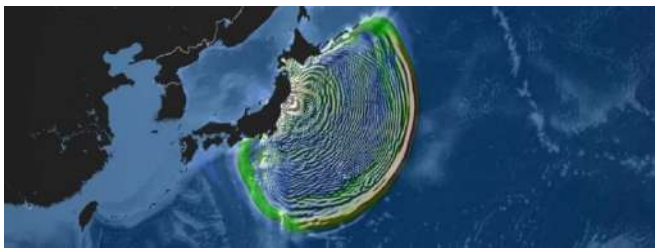
Source: GFZ GeoForschungsZentrum Potsdam, Helmholtz Centre

Researchers use gravity signals to improve earthquake early warning systems



Researchers have proposed a new algorithm that can describe a gravitational signal caused by earthquakes with great accuracy. The procedure could help in improving early warning systems for earthquakes or tsunamis in the future.

Earthquakes send out signals that proliferate at the speed of light and can be recorded before the relatively slow seismic waves. These signals are sudden changes in gravity caused by a shift in the Earth's inner mass.

Recently, these signals called Prompt Elasto-Gravity Signals (PEGS) were tracked by seismic measurements. With the help of PEGS, it is possible to spot an earthquake very early, even prior to the arrival of destructive quakes or tsunami waves.

However, the gravitational effect of this phenomenon is so small that it only amounts to less than one-billionth of the planet's gravity, which means PEGS can only be recorded for powerful earthquakes.

Furthermore, the process of their generation is complex as they are not only produced directly at the quake's source but also persistently as the tremor waves propagate through the Earth's interior.

There has been no exact method to simulate the generation of PEGS signals on computers. For the first time, the algorithm proposed by researchers from the GFZ German Research Center for Geosciences can calculate PEGS signals with great accuracy and less effort.

The researchers were able to present that the signals enable conclusions to be drawn about the strength, duration, and mechanism of very strong earthquakes.

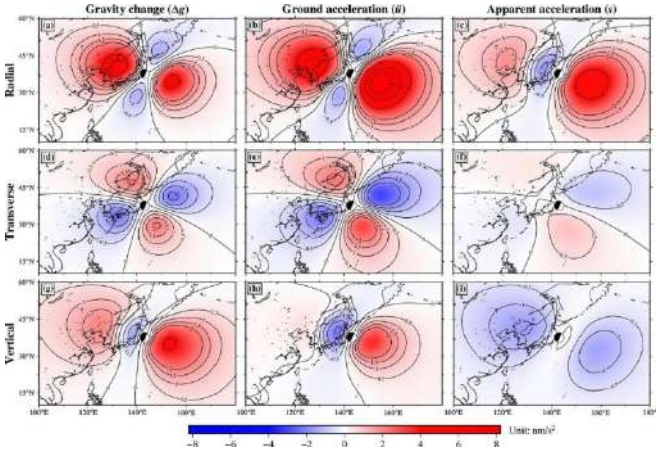
A tremor abruptly changes the rock slabs in the Earth's interior, thus also shifting the mass distribution in the Earth. This displacement can amount to several meters in powerful earthquakes.

"Since the gravity that can be measured locally depends on the mass distribution in the vicinity of the measuring point, every earthquake generates a small but immediate change in gravity," said researcher Rongjiang Wang.

However, every tremor also produces waves that change the density of rocks and gravitation for a short time. This oscillating gravity triggers secondary seismic waves.

"We faced the problem of integrating these multiple interactions to make more accurate estimates and predictions about the strength of the signals," said Torsten Dahm, head of GFZ section Physics of Earthquakes and Volcanoes.

"Wang had the ingenious idea of adapting an algorithm we had developed earlier to the PEGS problem-- and succeeded."



Spatial distribution of PEGS signal strength during the Tohoku quake in 2011, shortly before the arrival of the primary seismic wave. Image credit: Zhang, et al.

Sebastian Heimann, program developer and data analyst at GFZ explained how they tested their new algorithm, saying, "We first applied our new algorithm to the Tohoku quake off Japan in 2011, which was also the cause of the Fukushima tsunami."

"There, measurements on the strength of the PEGS signal were already available. The consistency was perfect. This gave us certainty for the prediction of other earthquakes and the potential of the signals for new applications."

Researchers added that by evaluating the changes in gravity further from the quake's epicenter off the coast, this method could be used in the future to identify whether a large earthquake is involved, which could trigger a tsunami.

"However, there is still a long way to go," said Wang. "Today's measuring instruments are not yet sensitive enough, and the environmentally induced interference signals are too great for the PEGS signals to be directly integrated into a functioning tsunami early warning system."

Reference

"Prompt elasto-gravity signals (PEGS) and their potential use in modern seismology" - Zhang, S. et al - Earth and Planetary Science Letters - DOI: 10.1016/j.epsl.2020.116150

Abstract

An earthquake causes a sudden rock-mass redistribution through fault rupture and generates seismic waves that cause bulk density variations propagating with them. Both processes induce gravity perturbations whose signals propagate with the speed of light and therefore can arrive at remote stations earlier than the fastest elastic P wave. In turn, the gravity perturbations generate secondary seismic sources everywhere within the earth, a part of which around the observation locations can cause ground motion prior to the direct P wave arrival there, too. Recently, these so-called prompt elasto-gravity signals (PEGS) of large seismic events like the 2011 Mw 9.1 Tohoku earthquake have been detected using the data recorded by broadband seismometers and superconducting gravimeters. Though the physics of the PEGS has been well understood, the tools used so far for a realistic modelling of them are complicated and computationally intensive. In this study, we present a new and straightforward approach that solves the full-coupled elasto-gravitational boundary-value problem more accurately, but no more complicated than to compute synthetic seismograms in a conventional way. Using the new tool, we simulate the complete PEGS of the 2011 Tohoku earthquake based on a realistic kinematic finite-fault source model. Furthermore, we present a comprehensive investigation of potential uses of PEGS in modern seismology. As an example, we show particularly that the major source parameters like the moment magnitude, the rupture duration and the focal mechanism of a megathrust earthquake like the 2011 Tohoku earthquake can be estimated robustly using the measured PEGS data.

(Julie Celestial / THE WATCHERS, February 26, 2020, https://watchers.news/2020/02/26/researchers-use-gravity-signals-to-improve-earthquake-early-warning-systems/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

The January 24, 2020 Mw 6.8 Elazığ (Turkey) Earthquake

Δημοσιεύτηκε το 16ο τεύχος της έκδοσης "**NEWSLETTER OF ENVIRONMENTAL, DISASTER, AND CRISIS MANAGEMENT STRATEGIES**" του ΠΜΣ "Στρατηγικές Διαχείρισης Περιβάλλοντος, Καταστροφών & Κρίσεων" του Εθνικού & Καποδιστριακού Πανεπιστημίου Αθηνών.

Στο **Newsletter** παρουσιάζονται σημαντικά γεγονότα στα σχετικά επιστημονικά πεδία, με στόχο την άμεση ενημέρωση της διεθνούς επιστημονικής κοινότητας και του κοινού.

Στο 16ο τεύχος παρουσιάζονται συγκεντρωτικά τα επιστημονικά και τεχνικά αποτελέσματα και δεδομένα που αφορούν στο **σεισμό Mw 6,8** που έπληξε το **Elazığ της Τουρκίας (24 Ιανουαρίου 2020)** και προέκυψαν στο πλαίσιο διεθνούς επιστημονικής και ανθρωπιστικής αποστολής, με τη συμμετοχή του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών.

Το τεύχος είναι προσβάσιμο στο σύνδεσμο: https://edcm.edu.gr/images/docs/newsletters/Newsletter_16_2020_Turkey_EQ.pdf

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Sinkholes in Karst

With few exceptions, the ground collapses that constitute the karst geohazard in engineering activity in limestone terrains are induced by human activity. Subsidence sinkholes, formed entirely within the soil profile, constitute the most widespread karst geohazard but are largely induced by engineered works, either directly or accidentally. Water table decline (as a result of pumped abstraction or quarry de-watering) and uncontrolled surface drainage input are the two key factors that induce subsidence sinkholes, especially where both are involved.

Collapse sinkholes, formed by a failure of bedrock over a cavity, are rare in natural karst landscapes, but may be induced by excessive loading imposed on limestone that lies above an open cave; the risks associated with this geohazard should be eliminated by the implementation of an appropriate site investigation that includes proof drilling.

Sinkholes are bowl-shaped, funnel-shaped, or vertical-sided depressions in the land surface that form over underground voids. These depressions can range from a few feet to several hundred feet in diameter, and usually, result from the natural collapse of soluble bedrock and overlying soil. Sinkholes can also result from mining, groundwater pumping, and leaking water, sewer, and stormwater pipes. Subsidence of the ground is usually gradual, but on occasions, it can be sudden and dramatic.

When it rains, a portion of the slightly acidic water percolates through the soil, comes into contact with the bedrock, and slowly dissolves mineral grains. In regions of carbonate bedrock, this process can create underground fissures and caves.

The surface of such a region is often pocked with depressions called sinkholes. Sinkholes are a characteristic feature of karst terrain. In well-developed karst terrain, chains of sinkholes form what is known as solution valleys and streams frequently disappear underground.

One of the fantastic examples of karst sinkholes was filmed in Bosnia and Herzegovina and belongs to one of the most famous karst areas on Earth – the Dinaric highlands in Southeast Europe:

https://www.youtube.com/watch?time_continue=33&v=OO6f6YD5vNo&feature=emb_logo

Sinkhole collapse, either slow or dramatic, can cause considerable damage to buildings, highways, rails, bridges, pipelines, storm drains, and sewers. In addition, sinkholes provide a pathway for surface water to directly enter groundwater aquifers. The increasing potential for pollution is particularly high due to the minimal filtering of surface water.

Most sinkholes form by the process of 'suffosion'. This is where loose, unconsolidated material including soil, 'head', loess and clay overlies fissures and joints in the underlying limestone, and material is washed into these fissures and into the caves beneath. Suffosion sinkholes tend to develop gradually (over months or years) as the covering sediment slumps into open fissures in the underlying limestone, creating a void which migrates towards the surface eventually creating a sinkhole.

Although a natural process, the formation of sinkholes is often accelerated or triggered by human actions. Broken land drains, water mains and sewerage pipes, increased rainfall, storm events, modified drainage and diverted surface water can all help wash sediment into the underlying limestone, causing subsidence. There have been many well-documented occurrences of sinkholes forming beneath broken water mains, unlined storm-water culverts and leaking swimming pools.

A poor understanding of karst terrain has led to land-use practices that pose significant economic and environmental impacts on households and communities. Sinkhole formation is closely related to local hydrological conditions, and human-induced changes to the local hydrology can accelerate the process. Diverting surface water, pumping groundwater, and constructing reservoirs can all contribute to sinkhole formation.

An extreme example occurred in Florida on February 25, 1998, when, during the flushing of a newly drilled irrigation well, hundreds of sinkholes up to a hundred and fifty feet across formed over a twenty-acre area within a few hours. Runaway urbanization and development dramatically

increases water usage, alters drainage pathways, and overloads the ground surface.

According to the Federal Emergency Management Agency, the number of human-induced sinkholes has doubled since 1930, while insurance claims for related damages have increased 1,200 % from 1987 to 1991, costing nearly $100 million. Subsidence is generally not covered by standard homeowners insurance.

Signs of sinkhole formation

Although a sinkhole can form without warning, specific signs can signal potential development:

- Slumping or falling fence posts
- Wilting vegetation
- Discoloured well water
- Structural cracks in walls, floors, or foundations.
- Cracks in soil/subsidence.

Silent danger

Infrastructure — buildings and transportation, communication and utility networks — is vulnerable to damage from a variety of geologic hazards, such as volcanoes and earthquakes. But karst geohazards are stealthy. They come silently from below, then unexpectedly make themselves known. And because they usually affect a segment of a utility line, or one home, or one short length of the highway, their cost is also stealthy. But the toll adds up.

Karst landscapes and aquifers form when water dissolves limestone, gypsum and other rocks. The surface expression of karst includes sinkholes, sinking streams and springs.

The economic losses of karst hazards are largely hidden because they are scattered across an area the size of a state, and individually they affect small areas when compared to tornado damage, for example. Most people don't realize how much they are affected because the costs appear in the form of higher taxes and an increased cost of living.

The cost of repairing roads, preparing special foundations for large buildings (schools, for example) and extending public water lines to replace polluted groundwater all add to the costs of public projects.

Researchers foresee an increasing need for research on karst geologic hazards because of the accelerating pace of suburban development. Delineating karst groundwater basins is vital to protecting the quality of water discharged from springs and wells, and is an important tool for understanding the hydrology of sinkhole flooding, one of the most common karst hazards.

Damaging homes

Karst hazards include sinkhole flooding, sudden cover collapse, leakage around dams, the collapse of lagoons resulting in waste spills and radon infiltration into homes. Most noticeable are sinkhole flooding and cover collapse. Seldom are collapses reported to any central agency.

Sinkhole flooding is one of the more tragic hazards because it affects private residences the most.

Sinkhole flooding usually occurs during the same storms that flood rivers, so it is sometimes not recognized as karst related. Unlike a normal stream channel, the karst conduit has a fixed area that cannot increase in cross-section in response to floods. Because of the loss of energy to friction and the finite cross-sectional area of the karst conduits, large increases in water pressure are needed to increase, even by a small amount, the flow in cave passages.

Sinkholes can also flood when their outlets are clogged, preventing water from being carried away as fast as it flows in. Trash thrown into a sinkhole can clog its throat, as can soil eroded from fields and construction sites or a natural rockfall near the sinkhole's opening. Sometimes the conduit itself is too narrow because it has recently (in the geologic sense) captured a larger drainage basin.

The reach of a conduit downstream from constriction could carry a higher flow than it is receiving were it not for this restriction. Sinkholes flood more easily around development — roofs, parking lots, highways — which increases both the total runoff and the rapidity of runoff from a storm.

A second reason that sinkholes flood is because of backflooding, the outcome when the discharge capacity of the entire karst conduit network is exceeded. Some upgradient sinkholes that drain normally during the short, modest accumulation of storms, may actually become springs that discharge water during prolonged rainfall.

Sudden collapse

Cover collapse occurs when the soil collapses into an underlying grike, a fissure made larger as water dissolves limestone. Cover collapse is similar to subsidence, except that it happens suddenly in a small, focused location.

Both heavy rains or extended droughts can bring on cover collapse. Each weakens the soil over a grike, either by saturating the soil with water or robbing it of cohesion. Near buildings, downspouts and leaking utility pipes can accelerate the process. Eroded soil falls into the grike and water moves the soil to an underlying cave, forming a cavity in the mantling soil.

In high- flow events, water in the cave may backflood into the overlying soil. As the water recedes, the cave and grike drain faster than the soil, which means that saturated soil spans the void in the grike. The overloaded soil arch falls into the soil cavity and the cover collapses.

The erosion of soil into the underlying conduit does not automatically stop when an impermeable surface, such as a highway, parking lot or building, is constructed over the sinkhole. Lateral flow can easily continue to erode the soil. The typical scenario is when no local ordinance prevents a developer of a rural subdivision from filling sinkholes. The developer builds a house on a filled sinkhole from which the fill continues to be undermined. Subsidence results, sometimes decades after the developer is gone.

Sinkholes defined

Geologists classify sinkholes based on their geometry and how they developed. Understanding sinkhole dynamics is critical to detecting and mitigating damages these karst features can cause.

Collapse sinkholes occur when the bridging material over a subsurface cavern cannot support the overlying material. The cover collapses into the cavern and a large, funnel-shaped depression forms.

Solution sinkholes result from increased groundwater flow into higher porosity zones within the rock, typically through fractures or joints within the rock. An increase of slightly acidic surface water into the subsurface continues the slow dissolution of the rock matrix, resulting in slow subsidence as surface materials fill the voids.

Alluvial sinkholes are older sinkholes that have been partially filled with marine, wetland or soil sediments. These features are common in Florida, where the water table is shallow, and typically appear as shallow lakes, cypress "domes" and wetlands.

Raveling sinkholes form when a thick overburden of sediment over deep cavern calves into the void and pipes upward toward the surface. As the overlying material or "plug" erodes into the cavern, the void migrates upward until the cover can no longer be supported and then subsidence begins.

Different size of sinkholes

Sinkholes can range in size from a few feet or meters to over 100 meters (300 feet) deep. They've been known to "swallow" cars, homes, businesses, and other structures. Sinkholes often caused by the loss of groundwater from pumping.

A sinkhole can even collapse through the roof of an underground cavern and form what's known as a collapse sinkhole, which can become a portal into a deep underground cavern.

While there are caverns located around the world, not all have been explored. Many still elude spelunkers as there is no opening to the cave from the earth's surface.

Difference between a sinkhole and a pothole

A sinkhole is a closed natural depression in the ground surface caused by the removal of material below the ground and either collapse or gradual subsidence of the surface into the resulting void.

A pothole is usually a fairly small feature caused by a failure of paving materials, usually associated with roads, parking lots, and airports. In the colder parts of the country, potholes become more abundant in late winter and spring because of freeze-thaw damage to pavements. But beware of international terminology: British cavers refer to caves as potholes and call cave exploring "potholing".

There's also another kind of pothole. Parts of Canada and the central United States are covered by a region of wetlands called prairie potholes that were formed as Pleistocene Epoch glaciers receded around 12,000 years ago. The wetlands formed where water accumulated in small depressions in a landscape that is underlain by low-permeability glacial till. Prairie potholes are NOT collapse features.

Karst Caves

Inside karst caves, one might find a wide range of speleothems – structures created by the deposition of slowly dripping calcium carbonate solutions. Dripstones provide the point where slowly dripping water turns into stalactites (those structures which hang from the ceilings of caverns), over thousands of years which drip onto the ground, slowly forming stalagmites. When stalactites and stalagmites meet, they forum cohesive columns of rock. Tourists flock to caverns where beautiful displays of stalactites, stalagmites, columns, and other stunning images of karst topography can be seen.

Karst topography forms the world's longest cave system – the Mammoth Cave system of Kentucky is over 350 miles (560 km) long. Karst topography can also be found extensively in the Shan Plateau of China, Nullarbor Region of Australia, the Atlas Mountains of northern Africa, the Appalachian Mountains of the U.S., Belo Horizonte of Brazil, and the Carpathian Basin of Southern Europe.

https://geologyengineering.com/structural-geology/sink-holes-in-karst/?fbclid=IwAR3Ng0VbLJpXqMY6EM6Oz4fCPJNkrDrwlyK-2-3KXkpByG2Qdm0So1jpWqE

Plate tectonics runs deeper than we thought

At 52 years old, plate tectonics has given geologists a whole new level to explore.

It's right there in the name: "plate tectonics." Geology's organizing theory hinges on plates—thin, interlocking pieces of Earth's rocky skin. Plates' movements explain earthquakes, volcanoes, mountains, the formation of mineral resources, a habitable climate, and much else. They're part of the engine that drags carbon from the atmosphere down into Earth's mantle, preventing a runaway greenhouse climate like Venus. Their recycling through the mantle helps to release heat from Earth's liquid metal core, making it churn and generate a magnetic field to protect our atmosphere from erosion by the solar wind.

The name may not have changed, but today the theory is in the midst of an upgrade to include a deeper level—both in our understanding and in its depth in our planet. "There is a huge transformation," says Thorsten Becker, the distinguished chair in geophysics at the University of Texas at Austin. "Where we say: 'plate tectonics' now, we might mean something that's entirely different than the 1970s."

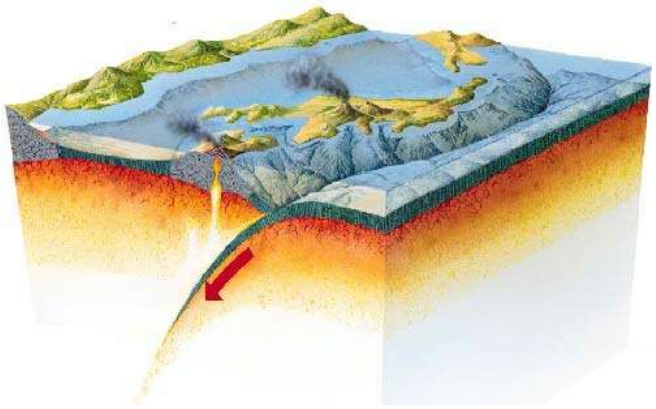
Þingvellir or Thingvellir, is a national park in Southwestern Iceland, about 40km northeast of Iceland's capital, Reykjavík. It's a site of geological significance, as the visuals may indicate.

Plate Tectonics emerged in the late1960s when geologists realized that plates moving on Earth's surface at fingernail-growth speeds side-swipe each other at some places (like California) and converge at others (like Japan). When they converge, one plate plunges down into Earth's mantle under the other plate, but what happened to it deeper in the mantle remained a mystery for most of the 20th century. Like an ancient map labeled "here be dragons," knowledge of the mantle remained skin-deep except for its major boundaries.

Now a marriage of improved computing power and new techniques to investigate Earth's interior has enabled scientists to address some startling gaps in the original theory, like why there are earthquakes and other tectonic phenomena on continents thousands of miles from plate boundaries:

"Plate tectonics as a theory says zero about the continents; [it] says that the plates are rigid and are moving with respect to each other and that the deformation happens only at the boundaries," Becker told Ars. "That is nowhere exactly true! It's [only] approximately true in the oceanic plates."

There are other puzzles, too. Why did the Andes and Tibet wait tens of millions of years after their plates began to converge before they grew tall? And why did the Sea of Japan and the Aegean Sea form rapidly, but only after plates had been plunging under them for tens of millions of years?



The subduction of a tectonic plate.

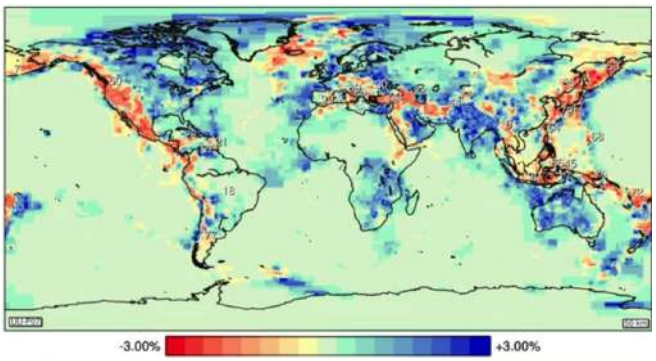
"They've been puzzling us for ages, and they don't fit well into plate tectonic theory," says Jonny Wu, a professor focused on tectonics and mantle structure at the University of Houston. "That's why we're looking deeper into the mantle to see if this could explain a whole side of tectonics that we don't really understand."

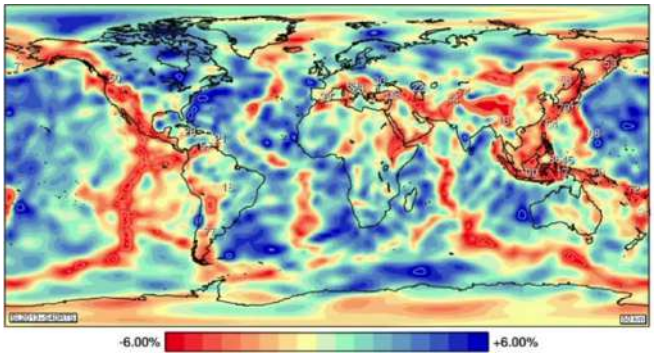
Plate Tectonics meet Slab Tectonics

The Plate Tectonics theory's modern upgrade is the result of new information. Beginning in the mid-1990s, Earth's interior has gradually been charted by CAT-Scan-like images, built by mapping the echoes of powerful earthquakes that bounce off features within Earth's underworld, the way a bat screeches to echo-locate surroundings. These "seismic tomography" pictures show that plates that plunge down from the surface and into the mantle ("subduct" in the language of geologists) don't just assimilate into a formless blur, as often depicted. In fact, they have a long and eventful afterlife in the mantle.

"When I was a PhD student in the early 2000's, we were still raised with the idea that there is a rapidly convecting upper mantle that doesn't communicate with the lower mantle," says Douwe van Hinsbergen, a professor of global plate tectonics at the University of Utrecht. Now, that seismic tomography shows "unequivocal evidence that subducted lithosphere [plate material] goes right down into the lower mantle." This has settled decades of debate about how deep the heat-driven convection extends through the mantle.

van Hinsbergen and his colleagues have mapped many descending plates (dubbed "slabs"), scattered throughout the mantle, oozing and sagging inexorably toward the core-mantle boundary 2,900 kilometers (1,800 miles) below our feet, in an "Atlas of the Underworld." Some slabs are so old they were tectonic plates on Earth's surface long before the first dinosaurs evolved.





https://vimeo.com/364073878

Moving through the mantle from top to bottom, blue areas are roughly equivalent to subducting slabs. Top panel seismic tomography based on earthquake P (*primary*) waves, bottom panel seismic tomography based on earthquake S (*secondary*) waves. Credit: *van der Meer et al Tectonophysics 2018, atlas-of-the-underworld.*

Fluid solid

Slabs sink through the mantle because they are cooler and therefore denser than the surrounding mantle. This works because "the Earth acts as a fluid on very long timescales," explains Carolina Lithgow-Bertelloni, the endowed chair in geosciences at UCLA.

High-pressure, high-temperature diamond-tipped anvil apparatuses can now recreate the conditions of the mantle and even the center of the core, albeit on a tiny scale. They show that rock at mantle pressures and temperatures is fluid but not liquid, solid yet mobile—confounding our intuition like a Salvador Dali painting. Here rigidity is time-dependent: solid crystals flow, and ice is burning hot.

But even by the surreal standards of Earth's underworld, a layer within the mantle between 410 and 660 kilometers (255-410 miles) deep is especially peculiar. Blobs in diamonds that made it back from there to Earth's surface reveal it to be rich in water, where carbon, that once was life on—or in—the seafloor, waits as carbonate minerals to be recycled into the atmosphere, where diamonds grow fat over eons before, occasionally, being recycled into the crowns of royalty. Earthquake waves are distorted as they pass through it, showing the 660-kilometer-deep boundary has mountainous topography with peaks up to 3 kilometers (2 miles) tall, frosted with a layer of weak matter.

Called the "Mantle Transition Zone," this layer is a natural consequence of the increasing weight of the rock above as you go deeper underground. At certain depths, the pressure forces atoms to huddle tighter together, forming new, more compact minerals. The biggest of these "phase transitions" occurs at a 660-kilometer-deep horizon, where seawater that was trapped in subducting slabs is squeezed out of minerals. The resulting dryer, ultra-dense, and ultra-viscous material sinks down into the lower mantle, moving more than 10 times slower than it did in the upper mantle.

For sinking slabs, that's like a traffic light on a highway (in this analogy your commute takes about 20 million years, one-way), so slabs typically grind to a halt like cars in a traffic jam when they hit the 660-kilometer level. Seismic tomography shows that they stagnate there, sometimes for millions of years. Or, they pile-up, buckle, and concertina. Or, they slide horizontally. Or, sometimes they just pierce the Transition Zone like a spear.

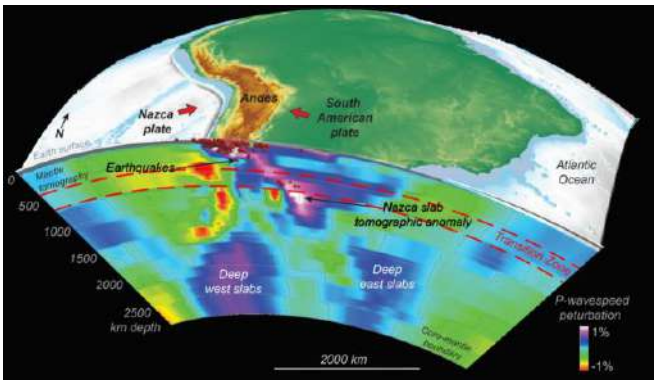
It's these differences in how slabs cross the Mantle Transition Zone that's the key to explaining those puzzling phenomena on Earth's continents.

Pulling back the subducted bedsheet

To see how the Andes were affected when a slab crossed the Mantle Transition Zone, Wu's PhD student Yi-Wei Chen worked with Wu and structural geologist John Suppe, using seismic tomography pictures of the Nazca Slab that's in the mantle under South America.

They clicked the equivalent of an "undo" button to "un-subduct" the slab: "Like a giant bedsheet that's fallen off the bed, we could slowly pull it back up and just keep pulling and see how big it was," says Wu. Their technique is borrowed from the way geologists flatten-out contorted crustal rocks in mountain belts and oil fields to understand what the layers were like before they were folded. Using the age of the Pacific Ocean floor, the rate that ocean plates are being manufactured at midocean ridges, and the configuration of those ridges, the team compared the subduction history of South America with a large database of surface geological observations, including the timing of volcanic eruptions.

"Our plate model is just a model, but there is a huge catalog of tectonic signals, especially magmatism, to work with," says Wu. "We started to see a link between when the slab reached the mid-mantle viscosity change and things that were happening in the surface."



A slice through Earth's mantle under the Andes.

They found that the main uplift of the Andes was delayed by 20–30 million years after the most recent episode of subduction began, a delay that matches the time for the slab to arrive at, stagnate in, and then sink below the Mantle Transition Zone. Delays like that—millions of years between the start of subduction and the start of serious mountain building—have also been recognized in Turkey and Tibet.

How can a slab sinking through the Mantle Transition Zone build mountains on an entirely different plate, 660 kilometers away through the mantle?

It's a mantle wind that blows continents into mountains

"If you take something that's dense and you make it go down, that's going to generate flow everywhere, and that is the 'mantle wind,' so there's nothing mysterious about it!" says Lithgow-Bertelloni.

Geodynamicists like Lithgow-Bertelloni and Becker use a different approach than Wu's bedsheet-like un-subduction process. Instead, they code the equations of fluid dynamics into computer models to simulate the flow of high-pressure rock. These models are constrained by the physical conditions in Earth's mantle gleaned from high-pressure experiments and by the properties of earthquake waves that have traveled through those depths. By playing a "video" of these simulations, scientists can check the behavior of slabs in their models against the "ground truth" of seismic tomographic im-

ages. The better they match, the more accurately their models represent how this planet works.

"How the geometry evolves has to conform to physics," says Becker. "The deformation is different in the mantle from the shallow crust because things tend to flow rather than break, as temperatures and pressures are higher."

Their models show that, as slabs sink below the Mantle Transition Zone, they suck mantle down behind them, creating a far-reaching downwelling current of flowing rock. And it's that down-going gust of mantle wind that drags continental plates above it, like a conveyor belt, compressing them and squeezing mountain belts skyward in places like the Andes, Turkey, and Tibet.

The location of the slabs relative to that 660-kilometer horizon determines what *kind* of mountain chain you get. If a subducting slab hasn't yet sunk below the 660-kilometer layer, you get the kind of mountains envisaged by classic plate tectonics—without extreme altitudes and confined to a narrow belt above the subducting slab. Examples include the ones around the Western Pacific and Italy: "We think the present-day Apennines are an example of that," says Becker.

The bigger mountain belts east of the Pacific and the Tibetan Plateau are in a different category: "Once the slab transitions through the 660, you induce a much larger scale of convection cell. That's when we are engaging what we call whole mantle 'conveyor belts.' And it's when you have those global conveyor belts and symmetric downwelling rather than a one-sided downwelling, that's when you get a lot of the [mountain building]," Becker said.

So one slab sinking below the Mantle Transition Zone can create a mantle undertow that squeezes up mountains on an entirely different plate, 660 kilometers above it. This new level of tectonics now makes sense of other geological puzzles.

What's stressing Asia?

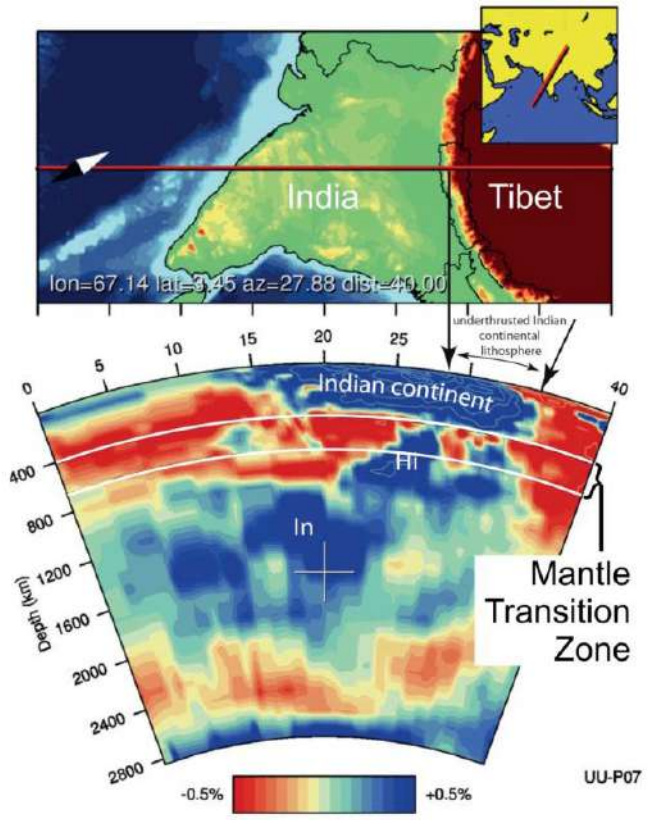
The Tibetan Plateau north of the Himalayas is known as the "Roof of the World" because it stands an average of 4.5 kilometers (15,000 feet) above sea level. It achieved that altitude around 34 million years ago, some 24 million years after the Indian continent began to collide with Asia, and more than 100 million years after seafloor first began to plunge into the mantle under South Asia.

"The surface elevation of the Tibetan Plateau was acquired after much of the crustal deformation took place, suggesting that processes in the underlying mantle may have played a key role in the uplift," van Hinsbergen commented in the journal Science recently.

During those 100 million years, the oceanic slab attached to India seems to have stagnated and then penetrated the mantle's 660-kilometer layer several times before the Indian continent finally collided with Asia. With that collision, continental crust began to plunge into the mantle. But it took millions of years for that continental rock, more buoyant than the oceanic rock that preceded it, to cause a slab pile-up in the Mantle Transition Zone beneath Tibet. India's slab buckled and broke off, releasing the amputated Indian plate to buoy up the Tibetan Plateau.

The fact that India continues, even today, to bulldoze its way under Asia, long after the continents collided and the slab broke off, has been another puzzle for geologists. It shows that forces beyond classic plate tectonics must be at work.

But India's continued motion isn't the only mystery of Central Asia. Lake Baikal in Siberia occupies a deep rift in Earth's crust caused by stresses that pull the crust there apart, and across Central Asia there are San-Andreas-like fault zones responsible for devastating earthquakes. These are out of place for classic plate tectonics since they are thousands of miles from a plate boundary. What, then, is stressing the interior of Asia?



Seismic tomographic slice through India and Tibet showing the broken-off Himalaya Slab (Hi) and older Indian slab (In) sinking toward the core.

The answer is, again, blowing in the mantle wind.

"This is not due simply to the fact that India has collided into Asia. This is the result of longstanding subduction in the region. You have compression all through the Japan subduction zone and into Indonesia and India," says Lithgow-Bertelloni. "There's been a ring of compression and there's been downwelling, and that's what gives you the regional stress pattern today."

In other words, in parts of the world where the mantle wind converges and sinks, it drags plates together forming big mountain chains. Farther away from that convergence, the same mantle flow stretches the overlying plates, causing rifts and faults.

Becker and Claudio Faccenna of Roma TRE University linked the downwelling current under East Asia to upwelling of hot mantle rock under Africa, a giant circuit of mantle wind that drives India and Arabia northward today. With Laurent Jolivet of the Sorbonne University, they reason that this mantle wind flows under Asia, stressing those Central Asian faults and rifting the ground under Lake Baikal. They also think it may have stretched East Asia apart to form a series of inland lakes and seas, like the Sea of Japan.

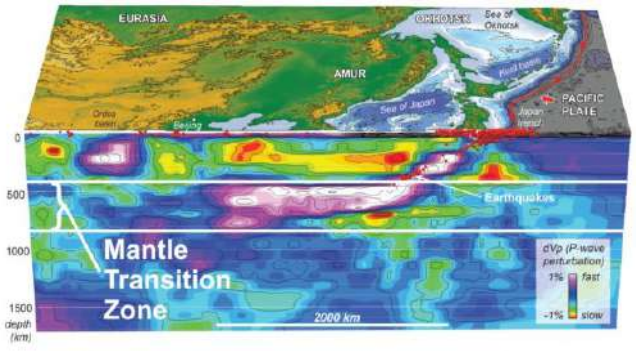
Slab syringe?

Wu thinks those East Asian seas and lakes might instead owe their origin to a different gust of mantle wind: "East Asia is puzzling in that you have these marginal basins that have formed since the Pacific Slab began to subduct under that

region. We think the Pacific Slab began to subduct around 50 million years ago and, shortly after that, many of these marginal basins opened up, including the Japan Sea, the Kuril Basin, the Sea of Okhotsk. We don't really have a good idea why they formed, but the timings overlap."

Japan was part of the Asian mainland until about 23 million years ago, when it rapidly (for geologists) swung away from the mainland like double saloon doors in an old western movie: "These doors swung open very quickly, apparently in less than 2 or 3 million years. The Japan Slab [is] underneath Beijing today, 2,500 kilometers inland. It's puzzling that it's so far inland, and it can be followed all the way back to the actual Pacific Slab today," Wu told me at the AGU conference in Washington, DC, last December. "What we've shown at this conference is that slab is most likely all Pacific Slab, and it looks like this slab has to move laterally in the Mantle Transition Zone."

In other words, rather than sinking further down into the mantle, the Pacific Slab seems to have slid sideways in the Mantle Transition Zone, hundreds of kilometers beneath the Asian Plate on the surface. Like a syringe plunger, it must have squeezed mantle material out of its way, and it could be that fugitive flow of mantle that stretched East Asia apart to create the Sea of Japan, the Kuril Basin and the Sea of Okhotsk.



Seismic tomographic picture showing the subducted Pacific Slab (white to purple colors) extending in the Mantle Transition Zone as far as Beijing.

Perhaps. Wu is the first to say this is speculative, but it's an idea that's consistent with plate reconstructions by other scientists. It also fits the weird, water-rich properties of the Mantle Transition Zone, with weak minerals and pockets of fluid that would lubricate the slab's penetration sideways rather than downwards. Fluid-dynamic computer models expect a weak lubricating layer at the 660-kilometer horizon. "We see this in the numerical simulations of convection," says Lithgow-Bertelloni. "You see a lot of horizontal travel because the slab can't go down because of a combination of things that are going on in terms of the viscosity structure and the phase transitions, and so it gets trapped in the Transition Zone, and so it has to travel."

Becker is more skeptical: "How far the slab under Asia travelled laterally is a very interesting question that a lot of people are thinking about, and it's one that comes down to what sort of tomographic models you look at," he says.

Science by upgrade not by uproot

It's skepticism like Becker's that drives science forward through a never-ending trial by data. Scientists try to break a theory by throwing observations at it to see if it handles them. New data and new techniques sometimes throw up puzzles that demand upgrades or bugfixes to the theory, but most of the theory tends to remain intact. So it is, and always has been, with plate tectonics. Even though its key ideas crystallized in 1967, it didn't arrive fully formed in a blinding "eureka!" moment. It was built on discoveries and ideas from more than two dozen scientists over six decades until it explained a range of geological and geophysical observations all over the world. That process continues today.

"What has changed dramatically since the late '90s is that we're now approaching understanding of plate tectonics that actually includes the continents!" says Becker.

Ironically this new direction harks back to the 1930s: "Arthur Holmes had a textbook in the 1930s where he associated mountain building such as the Andes with mantle convection," says Becker. When Alfred Wegner proposed that continents drifted, he lacked a mechanism for that. With hindsight it's strange that few made the link with Holmes' work: "For some reason science was not ready to make that connection," says Becker, "and it took until the establishment of seafloor spreading in the late '60s for people to make the link."

The grand challenge ahead

This new, deeper, understanding of plate tectonics is now rippling through the Earth sciences. "Modern tectonics no longer is restricted to classical concepts involving the movements and interactions of thin, rigid tectonic (lithospheric) plates," says a Grand Challenge report to the US National Science Foundation last year. So Earth scientists need to, "revisit our traditional definition of tectonics as a field."

Ramifications of a new plate tectonics theory extend far beyond geology, too, because it's woven into the fabric of other sciences, like long-term climate change and the habitability of exoplanets. We're also realizing that life and climate can affect plate tectonics over long timescales.

"Plate tectonics 2.0 is a model of Earth evolution that includes not just oceanic plates but includes the continental plates," Becker says. "And once you include continental plates then you have to worry about the processes such as sediments coming down from the mountains, lubricating the plate, carbon gets dumped on them, then carbon gets released at the subduction zones. Perhaps you might have control of subduction by climate."

van Hinsbergen puts it this way: "Undoubtedly we'll have major progress to make in the next decades. But the black box of the dynamics of our planet interior is now starting to be comprehensively constrained by observations, even as deep as to the core-mantle boundary."

So like the plates themselves, it seems plate tectonics as a theory will continue to shift, too.

(Howard Lee, 10.03.2019, https://arstechnica.com/science/2019/10/plate-tectonics-runs-deeper-than-we-thought)

Η Τηθύς και το επίθετό της

Ο ωκεανός που άνοιξε στην αρχή του Μεσοζωικού αιώνα και έκλεισε στο παλαιό μέρος του Καινοζωικού, μια ιστορία που λέγεται **αλπικός κύκλος**, έχει ονομαστεί **Τηθύς**, από το όνομα της... προγιαγιάς όλων, της **Τηθύος**.

Επώνυμο, βέβαια, οι θεοί δεν έχουν! Επίθετο όμως ναι! Για την **Τηθύ**, εξ όσων γνωρίζουμε, δεν παραδίδεται κάποιο επίθετο στην Ελληνική Γραμματεία. Πρέπει, λοιπόν, να το δημιουργήσουμε, κατ' αναλογίαν με άλλα υπάρχοντα. Ο σχετικός

με τον Ποσειδώνα είναι ποσειδώνειος/ποσειδώνιος, με τον Πλούτωνα πλουτώνειος/πλουτώνιος, με την Δήμητρα δημήτριος, με τον Απόλλωνα απολλώνειος/απολλώνιος, με τον Αισχύλο αισχύλλειος κ.ο.κ.

Ύστερα από μια συζήτηση που κάναμε στο περιθώριο του ΓΕΣΥ, καταλήξαμε ότι ως επίθετο της **Τηθύος** μπορεί να επιλεγεί το **τηθύειος/τηθύιος** και όχι ας πούμε το τηθυϊκός (κατά το οσφύς/οσφυϊκός), διότι τα «κτητικά» παράγωγα επίθετα από **κύρια ονόματα** σχηματίζονταν κυρίως με την κατάληξη **-ειος**, αλλά και με την απλούστερη **-ιος**.

Το αγγλικό αντίστοιχο επίθετο είναι **Tethyan**, με πάνω από 600.000 αποτελέσματα στην αναζήτηση Google. Τα τελευταία χρόνια, όμως, κάποιοι στην αγγλική βιβλιογραφία άρχισαν να χρησιμοποιούν την εκδοχή **Tethysian**. Η εκδοχή αυτή είναι προφανώς εσφαλμένη, αφού κατά την παραγωγή δεν έχει αφαιρεθεί η κατάληξη **-s**.

(Νίκος Καρράς / ΟΡΟΓΡΑΜΜΑ **Αρ.157 Ιούλιος – Αύγουστος 2019,** σελ. 3-4, http://www.eleto.gr)

Earth has a new geologic age: The Chibanian

It's all thanks to a cliff by a river in Japan.

A photo shows the cliffside in Japan's Chiba prefecture that's part of a line of sediment that recorded the geologic history of the planet between 770,000 and 126,000 years ago.

Earth has a new age: the Chibanian geologic time interval, which took place from 770,000 to 126,000 years ago, thanks to a layer of sediment found on a riverside cliff in southern Japan.

The Chibanian age was named after Chiba, the Japanese prefecture where the sediment was found, and was recently ratified by the International Union of Geological Sciences. That period is important because it included the most recent reversal of Earth's magnetic field, an article in Eos said. At various points in our planet's history, Earth's magnetic north and south poles have swapped locations. When that flip happens, it leaves a mark in rocks around the planet. The cliffside sediment in Chiba, Japan, may offer a richer record of that reversal than any other site on Earth.

That polar flip, known as the Brunhes-Matuyama reversal, is still the subject of some debate. A 2014 paper published in the Geophysical Journal International used information from a layer of sediment found in Italy to argue that the flip took place in the span of a few decades. A 2019 paper published in the journal Science Advances argued, relying on information from ancient lava flows in Hawaii, that the reversal took closer to 22,000 years. As an excellent geologic record of this flip, the Chiba sediment could eventually help resolve the debate.

Studying how the polarity reversal happened might help us understand what's going on today. Our planet's magnetic poles have wandered in recent years, and scientists don't fully understand why.

(Rafi Letzter - Staff Writer / LIVESCIENCE, 31.01.2020, https://www.livescience.com/new-geologic-age-chibanian.html?utm_source=Selligent&utm_medium=email&utm_campaign=9160&utm_content=LVS_newsletter+&utm_term=2744272&m_i=rEIr1A54IyzUUpI6e%2BOEz_ALt_MC8PW9xjIY0NzGPsrIYUX7VqlKTu3l5iQghocia-QKS8TPDlSGXVCXH7auOc5Y0lI6CVVWaXcU8YHIrrs)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΠΕΡΙΒΑΛΛΟΝ

US researchers develop living bricks

A living building material made with bacteria that can grow itself could lead to more sustainable buildings

Researchers at the University of Colorado Boulder in the US, have used active bacteria to create living bricks that can grow themselves, in order to design more sustainable buildings.

In a recent study published in the journal Matter, the researchers showed how living building materials (LBMs) could be engineered with the help of certain types of bacteria.

Wil Srubar, an engineer at the university, said "Nature has figured out how to do a lot of things in a clever and efficient way, we just need to pay more attention."

In the study, Srubar and the research team discovered that, under a range of humidity conditions, the living bricks have 'about the same strength as the mortar used by contractors today'.

The self-growing bricks were developed using a green microbe called cyanobacteria.

The microbe, which absorbs carbon dioxide (CO_2) as it grows, produces calcium carbonate – the main ingredient in both cement and limestone – as a by-product.

The Colorado Boulder researchers introduced the bacteria into a sand and gelatin solution and, eventually, engineered the bacteria's calcium carbonate by-product to mineralise the gelatine. This bound it to the sand and created a living brick that was both strong and capable of growing itself into a new brick if cut in half.

(CONSTRUCTION EUROPE, March 2020, p. 13)

Building materials come alive with help from bacteria

CU Boulder researchers have developed a new approach to designing more sustainable buildings with help from some of the tiniest contractors out there.

In a study published today in the journal *Matter*, engineer Wil Srubar and his colleagues describe their strategy for using bacteria to develop building materials that live and multiply—and might deliver a lower carbon footprint, to boot.

"We already use biological materials in our buildings, like wood, but those materials are no longer alive," said Srubar, an assistant professor in the Department of Civil, Environmental and Architectural Engineering (CEAE). "We're asking: Why can't we keep them alive and have that biology do something beneficial, too?"

You can't buy these microorganisms turned bricks at your local Home Depot just yet. But the researchers say that their ability to keep their bacteria alive with a high success rate shows that living buildings might not be too far off in the future.

Such structures could, one day, heal their own cracks, suck up dangerous toxins from the air or even glow on command.

"Though this technology is at its beginning, looking forward, living building materials could be used to improve the efficiency and sustainability of building material production and could allow materials to sense and interact with their environment," said study lead author Chelsea Heveran, a former postdoctoral research assistant at CU Boulder, now at Montana State University.

Rice crispy treats

Today's more corpse-like buildings materials, in contrast, can be costly and polluting to produce, Srubar said: Making the cement and concrete alone needed for roads, bridges, skyscrapers and other structures generates nearly 6% of the world's annual emissions of carbon dioxide.

Srubar's solution: Hire some bacteria.

In particular, he and his colleagues experimented with cyanobacteria belonging to the genus *Synechococcus*. Under the right conditions, these green microbes absorb carbon dioxide gas to help them grow and make calcium carbonate—the main ingredient in limestone and, it turns out, cement.

To begin the manufacturing process, the researchers inoculate colonies of cyanobacteria into a solution of sand and gelatin. With the right tweaks, the calcium carbonate churned out by the microbes mineralize the gelatin which binds together the sand—and, presto, a brick.

Top: Wil Srubar and CU Boulder graduate student Sarah Williams in the lab. Bottom: A mold for shaping bricks made out of living materials.

"It's a lot like making rice crispy treats where you toughen the marshmallow by adding little bits of hard particles," Srubar said.

As an added bonus, such bricks would actually remove carbon dioxide from the air, not pump it back out.

They're durable, too. In the new study, the team discovered that under a range of humidity conditions, they have about the same strength as the mortar used by contractors today.

"You can step on it, and it won't break," he said.

Buildings making buildings

The researchers also discovered that they could make their materials reproduce. Chop one of these bricks in half, and each of half is capable of growing into a new brick.

Those new bricks are resilient: According to the group's calculations, roughly 9-14% of the bacterial colonies in their materials were still alive after 30 days and three different generations in brick form. Bacteria added to concrete to develop self-healing materials, in contrast, tend to have survival rates of less than 1%.

"We know that bacteria grow at an exponential rate," Srubar said. "That's different than how we, say, 3D-print a block or cast a brick. If we can grow our materials biologically, then we can manufacture at an exponential scale."

He notes that there's a lot of work to do before that happens. The team's cyanobacteria, for example, need humid conditions to survive—something that's not possible in more arid regions of the world. So he and his team are working to engineer microbes that are more resistant to drying out so they remain alive and functional.

But the possibilities are big. Srubar imagines a future in which suppliers could mail out sacks filled with the desiccated ingredients for making living building materials. Just add water, and people on site could begin to grow and shape their own microbial homes.

"Nature has figured out how to do a lot of things in a clever and efficient way," Srubar said. "We just need to pay more attention."

Other coauthors of the new study include CU Boulder's Jeffrey Cameron, assistant professor in Biochemistry; Sherri Cook and Mija Hubler, both assistant professors in CEAE; postdoctoral researchers Juliana Artier and Jishen Qui; and graduate student Sarah Williams.

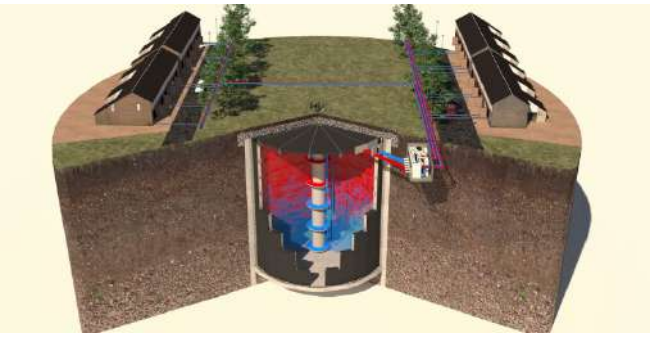
(Daniel Strain / CU Boulder Today, Jan. 15, 2020, https://www.colorado.edu/today/2020/01/15/building-materials-come-alive)

Start-up of the day: Underground hot water tank heats thousands of houses

About Ecovat

Ecovat has designed a system where a supersized tank can store hot water underground. "In conjunction with sustainable systems for generating energy such as solar thermal panels and a heat pump powered by wind energy, the Ecovat system is able to heat thousands of homes without any CO2 emissions in winter. And can cool these down in summer too," says founder Aris de Groot.

What motivated you to set up Ecovat and what problem did this resolve?



Ecovat's hot water vessel is 30 metres deep and is insulated with a layer of bubble glass

"In 2011 I looked into how you could make buildings more energy efficient on behalf of a client. It turned out that 80% of the average energy bill is spent on heat, most of which you use in winter. Whereas it's mainly in summer when you can generate plenty of sustainable energy, as is the case with thermal panels. Even though you don't actually need that heat right then. That's when I started thinking about a way to store the heat that you generate in the summer so that you can use it in the winter.

"So I came up with the idea of making a huge underground tank which you can fill up with water up to 95 °C. In order to store that heat, the tank is insulated with foam glass, a thick layer of glass with a structure that looks like the inside of a *Bros* chocolate bar. As the underground tank is so large – it's 30 meters in diameter and 30 meters deep and holds 20,000 cubic meters of water – it retains the heat better than if it were in a smaller tank. The larger the tank, the slower the rate that the water cools down. And the cheaper the heat becomes. The water can be extracted at several levels from the tank. The warmest water is at the top of the tank. The coolest water is at the bottom. That can be used in summer for cooling homes."

What was the main obstacle that you had to overcome?

"I had to find funding in order to flesh out my plan. And I had to figure out how to realize the Ecovat system technically. As far as the latter was concerned, it was a matter of trial and error. The insulation material was developed in collaboration with the TU/e in Eindhoven. That is 100 % sustainable and capable of withstanding pressures of up to 6 bar. It's built to last at least 50 years. We also had to develop software which could regulate the energy flows in the Ecovat system, e.g., for when a lot of sustainable energy is generated.

Sometimes it's the heat pump which is also part of the system that was problematic. Other times it was the thermal panels or the warm water coming from the Ecovat. The tricky thing is to make sure that the system is cost-effective and that all its functions are aligned properly with each other. After a pilot with a 2000 cubic metre tank in Uden between 2014 and 2017, it turned out that the Ecovat system really did work and that it is scalable. That means that if you connect a lot of houses to the Ecovat sytem, it will be commercially viable."

What has been the biggest breakthrough so far?

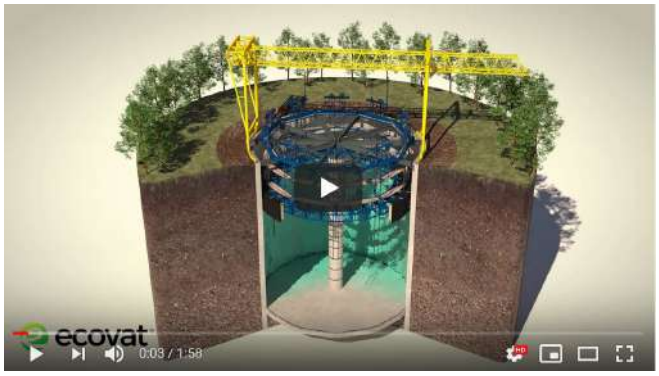
"That we also sorted out any issues that were there before the Ecovat system was up and running."

What can we expect from Ecovat in the coming year?

"That's when construction will start on our first commercial Ecovat system for Mijnwater, an energy supplier in Heerlen. This will hold 20,000 cubic metres of heated water. It will be connected to the existing heat network and will heat 2000 extra homes belonging to three housing corporations."

Where do you want to be in 5 years time with Ecovat?

"Then we'll be building four Ecovat systems each year, with a turnover of about €60 million."



https://www.youtube.com/watch?time_continue=3&v=baV6a1L3IqY&feature=emb_logo

(Lucette Mascini, Feb 3, 2020, https://innovationorigins.com/start-up-of-the-day-underground-hot-water-tank-heats-thousands-of-houses/?utm_medium=email&utm_content=K7uyxz5BWGwQT5EGkoszzdWkSH6tJItICn8D2SNfmI-hRHiAU-f5_k_l5Eq0DJsRY)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

Εντυπωσιακές κατεδαφίσεις μεγάλων κτιρίων

https://www.youtube.com/watch?v=Pm2OZnXEq2U

Реконструкция (анакατασκευή)

Работы по реконструкции здания. Главное - вовремя среагировать! (Work on the reconstruction of the building. The main thing is to react in time!)

https://www.facebook.com/nuzhdin.ml/videos/797217137093915/

Leonid Viktorovich Nuzhdin, 7 Απριλίου 2017

Ο Έλληνας Επιστήμονας που επιχειρεί να ξαναγράψει τη Φυσική των Σωματιδίων

Ανατρέποντας τις κυρίαρχες απόψεις για την ύλη και τα στοιχειώδη συστατικά της

Συνέντευξη με τον ακαδημαϊκό Κώστα Βαγενά

Ένας διακεκριμένος Έλληνας επιστήμονας, ο χημικός μηχανικός και φυσικοχημικός Κώστας Βαγενάς, μέλος της Ακαδημίας Αθηνών και της Εθνικής Ακαδημίας Μηχανικών των ΗΠΑ, ομότιμος καθηγητής του Τμήματος Χημικών Μηχανικών του Πανεπιστημίου Πατρών, επίτιμος καθηγητής του Αριστοτέλειου Πανεπιστημίου Θεσσαλονίκης και πρώην καθηγητής των πανεπιστημίων MIT και Yale, έχει αναπτύξει ένα ανατρεπτικό μηχανικό πρότυπο (μοντέλο), το οποίο, αν επαληθευτεί πλήρως, τότε θα πρέπει να ξαναγραφτούν πολλά βιβλία της Φυσικής παγκοσμίως.

Η επίλυση του μοντέλου που, όπως αναφέρεται στην τελευταία επιστημονική δημοσίευση του, είναι σε εξαιρετική συμφωνία με τα βιβλιογραφικά πειραματικά δεδομένα, δείχνει ότι οι θεμέλιοι λίθοι και η δομή της ύλης δεν είναι αυτοί που εδώ και δεκαετίες παρουσιάζει το λεγόμενο «Καθιερωμένο Πρότυπο» (Standard Model). Το νέο μοντέλο οδηγεί στο συμπέρασμα ότι οι μέχρι τώρα θεωρούμενες τέσσερις δυνάμεις της Φύσης είναι μόνο δύο, η Βαρύτητα και ο Ηλεκτρομαγνητισμός, καθώς η Ισχυρή και η Ασθενής Δύναμη ανάμεσα στα σωματίδια εξηγούνται από τη Βαρύτητα και την Σχετικότητα του Einstein, ο συνδυασμός των οποίων δημιουργεί την μάζα των συνθέτων σωματιδίων. Το πρότυπο αυτό λέγεται «Μοντέλο των Περιστρεφομένων Λεπτονίων» (Rotating Lepton Model ή RLM) και χρησιμοποιεί την μεθοδολογία του γνωστού μοντέλου Bohr για το υδρογόνο, με την Βαρύτητα ως κεντρομόλο δύναμη.

Ο κ. Βαγενάς και οι συνεργάτες του Δ. Τσούσης και Δ. Γρηγορίου του Πανεπιστημίου Πατρών, σε δημοσίευση τους στο περιοδικό «Physica A», χρησιμοποιούν το νέο μοντέλο για τον υπολογισμό των μαζών 15 συνθέτων σωματιδίων (πρωτονίων, νετρονίων, άλλων αδρονίων αλλά και μποζονίων) και επιτυγχάνουν εκπληκτική συμφωνία (με ακρίβεια 1%) με τις πειραματικές τιμές, χωρίς καμία άγνωστη παράμετρο. Επίσης δείχνουν ότι η ύλη αποτελείται από πέντε θεμελιώδη (Δημοκρίτεια, δηλαδή άτμητα) σωματίδια: τρία νετρίνα, το ηλεκτρόνιο και το ποζιτρόνιο (σωματίδιο αντιύλης με αντίθετο ηλεκτρικό φορτίο από το ηλεκτρόνιο). Τα κουάρκς, που αναγνωρίζει το «Καθιερωμένο Πρότυπο» ως θεμελιώδη σωματίδια, είναι στην πραγματικότητα, σύμφωνα με το νέο μοντέλο, ταχύτατα νετρίνα που κινούνται σε κυκλικές τροχιές με ταχύτητα πολύ κοντά στην ταχύτητα του φωτός.

Οι μεγάλες ταχύτητες των νετρίνων δημιουργούν, σύμφωνα με τον Αϊνστάιν, μεγάλη αδρανειακή και βαρυτική μάζα, ούτως ώστε δημιουργείται η μάζα των αδρονίων, όπως είναι τα πρωτόνια και τα νετρόνια. Από το νέο μοντέλο RLM συνεπάγεται ότι η Ισχυρή Δύναμη είναι απλώς η βαρυτική έλξη μεταξύ των σωματιδίων αυτών, που κινούνται περίπου με την ταχύτητα του φωτός. Δηλαδή η Ισχυρή Δύναμη είναι Σχετικιστική Βαρύτητα μεταξύ νετρίνων, ενώ η Ασθενής Δύναμη είναι Σχετικιστική Βαρύτητα μεταξύ νετρίνων και ηλεκτρονίων ή ποζιτρονίων.

Το Αθηναϊκό και Μακεδονικό Πρακτορείο Ειδήσεων ζήτησε από τον κ. Βαγενά να μιλήσει για το μοντέλο του και τα νέα αποτελέσματα:

ΕΡ: Ποιες είναι οι κυριότερες θεωρίες της σωματιδιακής Φυσικής που η δική σας θεωρία έρχεται να καταρρίψει;

ΑΠ: Η δική μας θεώρηση διαφέρει ουσιωδώς από το καθιερωμένο πρότυπο στο ότι, βασιζόμενοι μόνο σε θεμελιώδεις νόμους της Φυσικής, αποδεικνύουμε ότι η δύναμη που συγκρατεί τα συστατικά των πυρήνων, είναι βαρυτικής φύσεως. Δηλαδή περιγράφεται από ένα απλό συνδυασμό του βαρυτικού Νόμου του Νεύτωνα και της βασικής εξίσωσης της Ειδικής

Σχετικότητας του Αϊνστάιν, χωρίς να χρειάζεται επίκληση της Ισχυρής Δύναμης. Μια άλλη διαφορά είναι ότι στο προτεινόμενο μοντέλο δεν χρειάζεται να θυσιάσουμε την αιτιοκρατία των φυσικών νόμων της κίνησης, αλλά απλώς να τη συνδυάσουμε με τον κυματοσωματιδιακό δυισμό της ύλης, όπως έκανε ο Μπορ με το παγκοσμίως γνωστό μοντέλο του υδρογόνου.

Το «Μοντέλο των Περιστρεφομένων Λεπτονίων» (RLM) χρησιμοποιεί την μεθοδολογία του μοντέλου Bohr για το υδρογόνο. Άρα δεν δημιουργήσαμε κάποια νέα θεωρία, απλώς συνδυάσαμε ως μηχανικοί και φυσικοχημικοί τους γνωστούς νόμους της βαρύτητας του Νεύτωνα, της ειδικής σχετικότητας του Αϊνστάιν και την εξίσωση του De Broglie, που υπήρξε η βάση της κβαντομηχανικής.

Τα σύνθετα σωματίδια που αρχικά θέλουμε να περιγράψουμε, είναι το νετρόνιο και το πρωτόνιο, που εμπεριέχει και ένα ποζιτρόνιο. Η εικόνα που δημιουργούμε, είναι ότι καθένα αποτελείται από μία τριάδα περιστρεφομένων σωματιδίων, τα οποία διατηρούνται στην κυκλική τροχιά τους από την αμοιβαία βαρυτική τους έλξη.

Τα σωματίδια αυτά αποδεικνύουμε ότι είναι απλώς ταχέως περιστρεφόμενα νετρίνα με ταχύτητα πολύ κοντά στην ταχύτητα του φωτός, έτσι που, σύμφωνα με την ειδική Σχετικότητα του Αϊνστάιν, η μάζα τους αυξάνεται πολύ και φθάνει το ένα τρίτο της μάζας του πρωτονίου ή νετρονίου. Άρα τα κουάρκς του καθιερωμένου προτύπου είναι απλώς ταχέα -σχετικιστικά- νετρίνα.

Τέλος, το RLM αποδεικνύει ότι από τα 16 «θεμελιακά» σωματίδια του καθιερωμένου προτύπου, μόνο τα πέντε -ποζιτρόνια, ηλεκτρόνια και τα τρία νετρίνα- είναι θεμελιώδη με την Δημοκρίτεια έννοια σωματίδια, ενώ τα υπόλοιπα αποτελούν συνδυασμούς αυτών των πέντε ή δεν υπάρχουν, όπως π.χ. το γκλουόνιο.

ΕΡ: Ποια είναι η έως τώρα αντίδραση των Ελλήνων και ξένων συναδέλφων σας επιστημόνων, ιδίως των φυσικών, απέναντι στις αντισυμβατικές απόψεις σας που «ξαναγράφουν» τα βιβλία της Φυσικής;

ΑΠ: Πρέπει να τονισθεί ότι κανείς φυσικός μέχρι τώρα δεν έχει υποδείξει οποιοδήποτε σφάλμα στην συλλογιστική και στα μαθηματικά του RLM. Το καθιερωμένο πρότυπο έχει καταφέρει ορισμένες σημαντικές επιτυχίες στην περιγραφή των σωματιδιακών αλληλεπιδράσεων σε μια ευρεία περιοχή φαινομένων, όμως περιέχει 26 προσαρμοζόμενες σταθερές, δηλαδή 26 αυθαίρετες ρυθμίσεις, ενώ το RLM δεν περιέχει καμία.

Παρουσιάσαμε το μοντέλο μας κατόπιν προσκλήσεως δύο φορές, το 2017 και το 2019, στο παγκόσμιο συνέδριο Σωματιδιακής Φυσικής «Lomonosov Conference on Particle Physics» στη Μόσχα μπροστά σε περίπου 400 φυσικούς, κάθε φορά με μεγάλη επιτυχία. Λάβαμε μόνο εποικοδομητικές και εξαιρετικά ενδιαφέρουσες απορίες και σχόλια, περιλαμβανομένων των ιδιαίτερα κολακευτικών σχολίων του προέδρου του Συνεδρίου καθηγητή Αλεξάντερ Στουντενίκιν.

ΕΡ: Προ μηνών κάνατε μια επιστημονική περιοδεία σε κορυφαία αμερικανικά πανεπιστήμια παρουσιάζοντας τη θεωρία σας. Ποιες ήσαν οι αντιδράσεις;

ΑΠ: Οι ομιλίες που έδωσα σε επτά κορυφαία αμερικανικά πανεπιστήμια (MIT, Πρίνστον, Μπέρκλεϊ, Στάνφορντ, Caltech, Πανεπιστήμιο Νότιας Καλιφόρνιας και Καλιφόρνιας-Σαν Ντιέγκο), από 14 έως 30 Σεπτεμβρίου 2019, στέφθηκαν από μεγάλη επιτυχία, θετικότατες αντιδράσεις και εξαιρετικές ερωτήσεις. Βεβαίως οι περισσότεροι ακροατές ήσαν Φυσικοχημικοί και Χημικοί Μηχανικοί, όμως υπήρχαν και αρκετοί Φυσικοί που έθεσαν πολύ καλές και εποικοδομητικές ερωτήσεις.

ΕΡ: Πόσες ελπίδες έχει ένας Έλληνας επιστήμονας και μάλιστα χημικός να φέρει τα πάνω-κάτω στη Φυσική; Υπάρχουν συγκεκριμένα πειράματα που θα μπορούσαν να επιβεβαιώσουν τη θεωρία σας;

ΑΠ: Όταν η νέα θεώρηση είναι απλούστερη και υποστηρίζεται από το πείραμα, όπως στην προκειμένη περίπτωση από τις με ακρίβεια 1% υπολογιζόμενες μάζες 15 εκ των κυριοτέρων συνθέτων σωματιδίων χωρίς καμία προσαρμοζόμενη παράμετρο, τότε οι ελπίδες είναι σημαντικές, παρά τις δυσκολίες και την διαφορετική γλώσσα που χρησιμοποιούν οι δύο κοινότητες.

Όπως είναι αναμενόμενο, υπάρχει μεγάλη ποικιλομορφία στο τρόπο με τον οποίο η επιστημονική κοινότητα αντιμετωπίζει τη νέα θεώρηση. Όμως παρά τις δυσκολίες, έχουμε ήδη κάνει περί τις 20 δημοσιεύσεις σε καλά περιοδικά με κριτές, καθώς και σε ένα βιβλίο της Springer.

Ας μην ξεχνάμε ότι οι Φυσικοχημικοί έχουν ήδη παίξει στο παρελθόν σημαντικό ρόλο στη διαμόρφωση της σύγχρονης Φυσικής. Η εργασία μας δείχνει ότι υπάρχουν σημαντικοί δίαυλοι μεταφοράς χρήσιμης τεχνογνωσίας ανάμεσα στην Θεωρητική Φυσική και στην Φυσικοχημεία.

Πέραν της εντυπωσιακής συμφωνίας ανάμεσα στο πείραμα και στις -χωρίς άγνωστες σταθερές- προβλέψεις του μοντέλου για τις μάζες των 15 πλέον σημαντικών συνθέτων σωματιδίων, κάτι που το καθιερωμένο πρότυπο αδυνατεί εντελώς να κάνει χωρίς προσαρμοζόμενες παραμέτρους, υπάρχουν και άλλα, δύσκολα όμως, πειράματα που θα μπορούσαν να επιβεβαιώσουν το RLM, όπως η πραγματοποίηση των πειραμάτων εξαΰλωσης ζευγών ποζιτρονίων - ηλεκτρονίων στα εργαστήρια Superkamiokade και IceCube, που ευρίσκονται σε μεγάλο βάθος κάτω από την επιφάνεια της Γης, με συνέπεια την ύπαρξη μειωμένης συγκέντρωσης νετρίνων. Το RLM προβλέπει ότι ο σχηματισμός αδρονίων (αδρονοποίησης) από τα νετρίνα θα είναι σημαντικά μικρότερος σε αυτή την περίπτωση.

ΕΡ: Έχοντας μεγάλη πανεπιστημιακή/ακαδημαϊκή/ερευνητική πείρα εντός και εκτός Ελλάδος, πώς κρίνετε τις έως τώρα πρωτοβουλίες της κυβέρνησης στο χώρο των ΑΕΙ; Θα είχατε κάποια συμβουλή για την υπουργό κ. Κεραμέως;

ΑΠ: Οι πρωτοβουλίες της κ. Κεραμέως στον χώρο των ΑΕΙ έχουν γενικά αγαθές προθέσεις, που όμως θα κριθούν τελικά στην πράξη. Βασικό ζητούμενο είναι η βελτίωση της ποιότητας της διδασκαλίας και της έρευνας και η δημιουργία κλίματος συναίνεσης, σεβασμού των δικαιωμάτων όλων και η, σύμφωνα με τα διεθνή πρότυπα, απρόσκοπτη λειτουργία των Πανεπιστημίων μας.

Διδάσκω στο ελληνικό Πανεπιστήμιο επί 40 έτη, εκ των οποίων υπολογίζω ότι τα πέντε περίπου τα έχω περάσει, όπως και οι περισσότεροι συνάδελφοι και συνεργάτες μου, κλειδωμένοι έξω από τα γραφεία και εργαστήριά μας, ως αποτέλεσμα άχρηστων καταλήψεων, που από μόνες τους αποτελούν σε καιρό Δημοκρατίας παραβίαση του Πανεπιστημιακού ασύλου. Πρέπει να καλλιεργηθεί στο Πανεπιστήμιό μας ένα κλίμα σεβασμού των δημοκρατικών δικαιωμάτων όλων, φοιτητών και εργαζομένων.

Θα συμβούλευα την κ. Κεραμέως να περιορίσει, όσο είναι δυνατό, τις αρνητικές συνέπειες της πρόσφατης από τον κ. Γαβρόγλου ανωτατοποίησης των ΤΕΙ και της συνένωσης τους με τα Πανεπιστήμια, που είναι εντελώς αρνητικές για τα Πανεπιστήμια, για τα ΤΕΙ και για την χώρα. Επίσης θα την παρότρυνα να αγωνισθεί για την αύξηση των αποδοχών των διδασκόντων στα Πανεπιστήμια μας, για να περιορισθεί και να αντιστραφεί το brain drain και να ανέβει έτσι και η ποιότητα των Πανεπιστημίων μας, που έχει υποχωρήσει σημαντικά σε όλους τους δείκτες τα τελευταία 15 χρόνια.

ΕΡ: Κάποτε φύγατε από το MIT για να γυρίσετε στην Ελλάδα. Σήμερα θα συμβουλεύατε τους Έλληνες επιστήμονες στο εξωτερικό να κάνουν το ίδιο ή η διεθνής εμ-

πειρία είναι προτιμότερη;

ΑΠ: Η διεθνής εμπειρία είναι εντελώς αναγκαία, αν θέλουμε να είμαστε διεθνώς ανταγωνιστικοί. Στο Ισραήλ ήταν, και πιστεύω είναι, αναγκαστική προϋπόθεση για ένταξη σε βαθμίδα καθηγητική η διετής εμπειρία μετά το διδακτορικό σε υψηλής ποιότητας αμερικανικά ή ευρωπαϊκά πανεπιστήμια.

Ναι, θα συμβούλευα τους Έλληνες επιστήμονες του εξωτερικού να γυρίσουν, κατά προτίμηση όμως σε Τμήματα όπου κάποιοι από τους διδάσκοντες έχουν εργασθεί σε ξένα πανεπιστήμια και ερευνητικά κέντρα.

Προσωπικά, δεν μετανιώνω που άφησα το MIT και γύρισα στην Πάτρα το 1981. Ήμουν τυχερός που βρήκα καλούς συναδέλφους, συνεργάτες και φοιτητές και έτσι μπόρεσα και εκμεταλλεύτηκα αυτό που προσφέρει απλόχερα η πατρίδα μας: Πολύ χρόνο για σκέψη, διδασκαλία, έρευνα και δημιουργία.

Σύνδεσμος για την επιστημονική δημοσίευση:

https://www.sciencedirect.com/science/article/pii/S0378437119320515

Computation of the masses, energies and internal pressures of hadrons, mesons and bosons via the Rotating Lepton Model

C. G. Vayenas, D. Tsousis, D.Grigoriou

Highlights

- The masses of 15 composite particles were computed via the rotating lepton model.
- Some basic thermodynamic properties of these particles have been computed.
- The gravitational Bohr type analysis uses SR and has no adjustable parameters.
- The strong force can be modeled as relativistic gravity between neutrinos.
- The weak force can be modeled as relativistic gravity between neutrinos and e±

Abstract

The rotating lepton model (RLM) of composite particles is used in conjunction with special relativity, the equivalence principle of inertial and gravitational mass, and the de Broglie wavelength equation, to compute analytically the masses, potential energies and Hamiltonians of 9 hadrons, 3 mesons and 3 bosons without any adjustable parameters. The model is also used to derive analytical formulae for their confining force and internal pressure and to compare with the experimental values measured recently via deeply virtual Compton scattering (DVCS) and computed via lattice Quantum Chromodynamics (LQCD) calculations. Agreement between the RLM computed masses and the experimental ones is, surprisingly, within 1% and supports the previously proposed notion that the strong force can be modeled as a relativistic gravitational force between neutrinos, and that the weak force can be modeled as a relativistic gravitational force between electrons or positrons with neutrinos or antineutrinos.

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ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ

Project risk catalogue

Technical Committee
A.3 Risk Management

During the PIARC work program for TC A.3 Risk Management 2016-2019, a general, extensive PROJECT RISK CATALOGUE was prepared by WG2 members. To arrive at this catalogue, the working group conducted an effort that involved the documentation of their collective experiences, an extensive literature search, experience from previous cycles, findings from joint international seminars with TC E.1 Adaptation Strategies/Resiliency and E.3. Disaster Management, and experience from local experts from LMIC (Cuba, Vietnam).

The goal of the catalogue is to serve as a comprehensive tool that will help facilitate the risk management process, and supplement brainstorming sessions for the identification of relevant project risks. Although it was intended to be as comprehensive as practical, listing the most frequently occurring risks in major road projects, the catalogue is not intended to be inclusive of all possible risks.

The Risk Catalogue includes the following, broad categories:

- Geotechnical and Hydraulics
- Technical risks
- Financial Risks and Market Conditions
- Environmental and Health Issues
- Spatial Planning
- Political and Legal Issues (non-environmental)
- Organizational Aspects
- Hazards (Natural)
- Hazards (Man-made)
- Other.

Under each category, several examples of specific project risks are presented for the various project phases of planning/designing, delivery phase (construction), and maintenance/operation. Additionally, the Risk Catalogue includes suggestions for risk mitigation.

The Risk Catalogue should be helpful to those working on the identification of road project risks at any organizational level, and during any project stage. Risk workshop facilitators, risk managers, and project managers are likely to be interested in using the tool.

This workgroup recommends that the risk catalogue be further developed to improve the user-friendliness and convenience, and expand on its elements so that road organizations can better identify, analyze, and categorize project risks that are essential but often overlooked in the interest in achieving a sustainable development of road assets.

(PIARC Ref. : 2019R17EN, 2019, https://www.piarc.org/en/order-library?publication=30967&solo)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.issmge.org/filemanager/article/742/ISSMGE_BULLETIN_2020_FEB.pdf

Κυκλοφόρησε το Volume 14, Issue 1 του ISSMGE Bulletin (Φεβρουαρίου 2020) με τα παρακάτω περιεχόμενα:

- Research highlights – Geotechnical Engineering group, Kyoto University
- Message from Board-level committee: Corporate Associates Presidential Group (CAPG)
- TC corner – TC304/309/210: Machine Learning Dialogue for geotechnics 2019TC corner – TC symposium on "Laterites and lateritic soils"
- Conference reports
  - GeoSt.John's 2019, Canada
- ISSMGE Foundation reports
- Event Diary
- Corporate Associates
- Foundation Donors

Geo-Trends Review
A Crowdsourcing Magazine for the Geotechnical Engineering Community - Issue #10 - FEBRUARY 2020
www.mygeoworld.com/geotrends/issues/10-february-2020

International Geosynthetics Society

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

IGS NEWSLETTER – February 2020

Helping the world understand the appropriate value and use of geosynthetics

https://www.geosyntheticssociety.org/wp-content/uploads/2020/02/IGS-Newsletter-February-2020.pdf

- Make A Date In Your Diary With IGS READ MORE
- GeoAmericas 2020 Corporate Contest Deadline Extended! READ MORE
- GeoAmericas 2020 Deadline Extended For Early-Bird Registration! READ MORE
- Changing Practice By Changing Education – IGS North America Educates the Educators READ MORE
- Watch: Two For A Few With Dr. Dipanjan Basu And Edoardo Zannoni READ MORE
- Annual Meeting Success For UK Chapter READ MORE
- Call for Candidates for IGS Council: Term 2020 to2024 READ MORE
- Calendar of Events

READ MORE AT GEOSYNTHETICSSOCIETY.ORG

https://www.icevirtuallibrary.com/toc/jgein/27/1

Κυκλοφόρησε το Τεύχος 1 του Τόμου 27 (Φεβρουαρίου 2020) του Geosynthetics International της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

Impact of temperature on the pullout of reinforcing geotextiles from unsaturated silt, B. Ambriz, W. Mun, J. S. McCartney, 27(1), pp. 1–15

Compaction behavior of nonwoven geotextile-reinforced clay, M.-D. Nguyen, K.-H. Yang, W. M. Yalew, 27(1), pp. 16–33

GCL self-healing: fully penetrating hole/slit hydrated with RO water and 10 mM Ca solution, T.-K. Li, R. K. Rowe, 27(1), pp. 34–47

Hydraulic compatibility of geotextile-compost systems in landfill covers, S. C. Ryoo, A. H. Aydilek, 27(1), pp. 48–64

Modelling of geosynthetic-reinforced barriers under dynamic impact of debris avalanche, S. Cuomo, S. Moretti, A. D'Amico, L. Frigo, S. Aversa, 27(1), pp. 65–78

HDPE geogrid-residual soil interaction under monotonic and cyclic pullout loading, F. B. Ferreira, C. S. Vieira, M. L. Lopes, P. G. Ferreira, 27(1), pp. 79–96

Evaluation of effectiveness of geotextile in reducing subgrade migration in rigid pavement, B. Kermani, S. M. Stoffels, M. Xiao, 27(1), pp. 97–109

Κυκλοφόρησε το Τεύχος 1 του Τόμου 48 (Φεβρουαρίου 2020) του Geotextiles and Geomembrabes της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

https://www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/48/issue/1

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Visualisation and quantification of geogrid reinforcing effects under strip footing loads using discrete element method, Zhijie Wang, Felix Jacobs, Martin Ziegler, Guangqing Yang, Pages 62-70

Centrifuge tests to investigate global performance of geosynthetic-reinforced pile-supported embankments with side slopes, Panpan Shen, Chao Xu, Jie Han, Pages 120-127

https://www.icold-cigb.org/userfiles/files/NEWS-LETTERS/Icold-newsletter-N%C2%B018-2020.pdf

Κυκλοφόρησε το Newsletter της ICOLD, No. 18, February 2, 2020 με τα ακόλουθα περιεχόμενα:

Editorial

ICOLD Feature

Successes and Failures of Energy Transitions

The results of the German Laboratory

"By 2023 at the latest, we will be running into a shortfall in secure capacity"

From Costa Rica to Iceland, Hydropower countries are showing the way

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Board meetings in Porto and Denver

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ΕΕΕΕΓΜ

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