Exit Glacier, Kenai Fjords National Park, Alaska

ΕΛΛΗΝΙΚΗ
ΕΠΙΣΤΗΜΟΝΙΚΗ
ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

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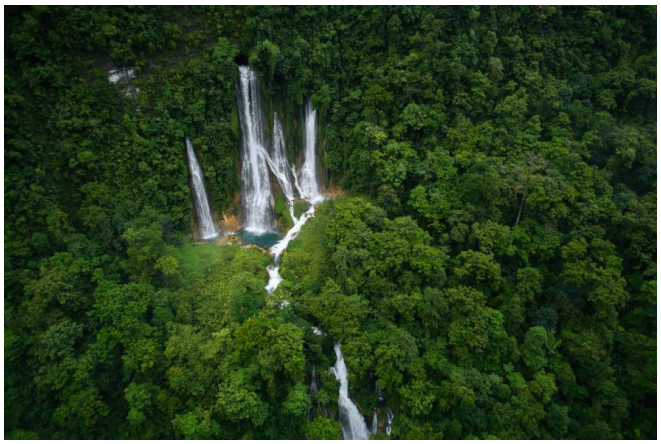


Waterfall, Mageni Cave, New Britain Island, Papua-New Guinea

Cavers, New Britain Island, Papua-New Guinea

Cavers are dwarfed by a limestone cavern in Rumbling Falls, Tennessee

ΑΡΘΡΑ

Better Bearing Capacity for Container Yard on Geocells

Constructing on weak subgrade is always a challenge, but geosynthetics provide high-quality, efficient, and economical solutions. An exemplary case can be found in the busy city of Kolkata, India, where a logistics company needed to improve a weak subgrade at the site of a new container yard. Geocells provided the answer.

ALLCARGO LOGISTICS Ltd.'s container yard was to be located at Kidderpore Dock. The zone was planned for transit storage heavy containers, which would be stacked five-high. The subsoil included 7 – 8 meters of riverine deposits, comprising of soft clay topped by about 3m of heterogeneous fill.

CHOOSING AN ENGINEERING STRATEGY

A container yard typically has two major issues, each of which impacts construction decisions and long-term maintenance:

- Heavy pressures from container stacks
- Non-uniform settlements of the ground

The typical approach to improving this type of site would involve subsoil consolidation through the installation of prefabricated vertical drains (PVDs) and preloading the area with placement of a surcharge. This is a slow process that requires close monitoring of settlements as the surcharge is placed in stages. Surcharging usually involves large quantity of earthwork to progressively achieve the final load, often equivalent to the load to be transferred from the loading system.

The container yard location was important, but the pre-existing site conditions were not favorable to supporting the heavy loads the yard would need.

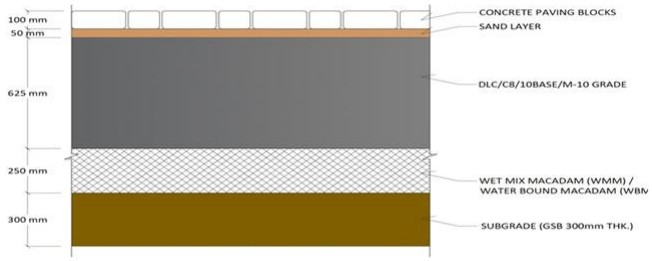
To achieve the appropriate bearing capacity for each surcharge stage and support the very heavy loads for the service life of the proposed container yard site, significant earthworks and time would have been required in Kolkata. It was considered too time and cost-intensive.

Strata's geotechnical specialists proposed a geocell-centered design that could be efficient to construct and even eliminate a concrete layer.

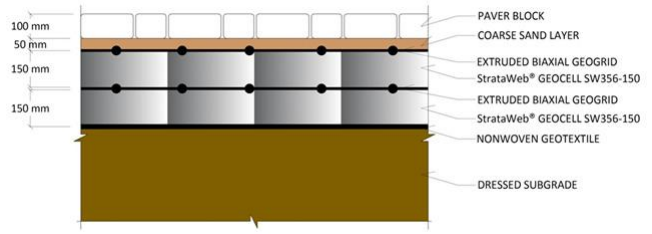
The StrataWeb® system utilized for the container yard incorporated the geocell layer within the paving to reduce the bearing pressures on the subsoil. This provided a thinner pavement design without sacrificing bearing capacity or safety. Combined with the easy-to-place infill, the StrataWeb® system addressed the differential settlement issues and provided an even working ground.

CONTAINER YARD ENGINEERING DESIGN

The engineering analysis demonstrated that the imposed pressures with a section reinforced with StrataWeb® SW 356-150 (Weld spacing 356 mm; cell depth 150mm) would be well within the safe bearing capacity of the subgrade. The design included two layers of the geocell to bear the load spread. The geocell was infilled and topped with 10mm of down-graded gravel. A layer of StrataBase® geogrid was included to further strengthen the section and improve the performance.



Conventional pavement design for the container yard



The thinner design of the geocell-based system enable quicker construction with a higher bearing capacity.

PROJECT TAKEAWAYS

For the new Kolkata container yard to opt for the geocell design, a number of added value was realized:

- Saved up to 15% of the cost compared to conventional methods
- Rapid installation due to the easy transportation of the geocells
- Use of locally available, cheaper materials
- Increased life span with lower maintenance
- Load spread ensured that bearing pressures were within safe limits
- Uniform settlements and even working ground

For more information about StrataWeb® geocell systems, reinforcement geosynthetics, and more, visit Strata Geosystems' website, www.strataindia.com.

Simple placement of infill over geocell.

Finished pavement design.

KOLKATA CONTAINER YARD PROJECT DETAILS

Location: Kidderpore Docks, Kolkata, India
Principal Client: ALLCARGO LOGISTICS Limited
Consultant: Shanghvi and Associates Consultants Pvt. Ltd.
Application: Paved area to support five-container high stacks
System Offered: Paved section incorporating StrataWeb®

(Chris Kelsey / Geosynthetica, October 23, 2017, http://www.geosynthetica.net/container-yard-bearing-capacity-geocells)

ΝΕΑ ΑΠΟ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

Professor Charles Ng elected as ISSMGE President 2017 – 2021 at the Seoul Council Meeting!

Message from the New President of ISSMGE

Dear colleagues,

It is my great honour to be elected as the 17th President of the ISSMGE. Having served the Board of ISSMGE as an appointed member and the board-level Awards Committee as the chair since 2010, I see aspects of the Society that could be improved. With your help, I intend to effect changes in three areas: education, innovation and diversity.

(i) Education

- Establishing the "ISSMGE university": Although we now live in the 21st century, many of our members still do not have access to quality undergraduate education. In some cases, fundamental concepts in soil mechanics are poorly taught. We can help these members by providing free short courses via the massive open online course (MOOC) platform. Such undergraduate-level courses would neatly complement our existing webinar lectures which can be regarded as equivalent to postgraduate courses. The provision of both online courses and webinar lectures would be the mission of the "ISSMGE university".

- Providing open access to all ISSMGE-related publications, honours lectures, videos, and more: The free flow of information and knowledge is vital to promoting scientific advancement and the exchange of ideas. Professor Roger Frank, my predecessor, had started promoting an open access policy in the ISSMGE. I would like to continue and expand this policy to cover more areas and a wider range of media. Naturally, the open access materials and information would form the "library" of the "ISSMGE university".

- Reviewing the functionality and performance of technical committees (TCs): One of the major missions of the ISSMGE is to advance scientific knowledge in soil mechanics and geotechnical engineering and this would not be possible without our TCs. I envision them contributing to the "ISSMGE university" in a number of ways. The functionality and performance of each TC have a profound influence on the ISSMGE. Under the leadership of the board-level committee, the Technical Oversight Committee (TOC), the functionality and performance of existing TCs will be critically reviewed. Some may be disbanded and new ones may be formed.

- Raising the profile of geotechnical engineers: The importance of geotechnical engineers in the world today and tomorrow cannot be understated. Several initiatives to be prioritized by the ISSMGE Board will be implemented to raise the profile of geotechnical engineers and render their multifaceted role more visible beyond the field itself. These initiatives include posting featured stories of achievements and contributions made by geotechnical engineers on social media and other public channels.

(ii) Innovation

- Setting up a platform for geotechnical-related startups and spinoffs and introducing machine learning in geotechnical engineering: The world is moving fast. We must try to advance ourselves as fast as possible. We should encourage our members to think outside the box to innovate and establish geotechnical-related startups and spinoffs. Moreover, we should collaborate with other disciplines to learn and make use of the latest data analytics and perhaps introduce big data research and management in geotechnical engineering. New TCs should be formed to tackle these challenges.

- Creating an ISSMGE app and a dynamic online forum: Currently, the communication between the Board and individual members occurs mainly via the secretariat of each member society. This mode of communication can be very ineffective. It is high time that we develop an ISSMGE app to facilitate more effective communication with members in different corners of the world. This would also help bring our society, which was established in the 1930s, to the 21st century.

(iii) Diversity

- Connecting with forgotten societies and exploring new ones: Currently we have over 90 member societies, but many of them are relatively inactive or even forgotten such as those in South America and some in Asia and Africa. We must take the initiative to awaken them and reconnect with them. Moreover, we must continue to look for new members by expanding our reach around the world.

- Boosting Corporate Associates to narrow the gap between academics and practitioners: There is a significant gap between academics and practitioners in our society. Under the leadership of the board-level committee, the Corporate Associates Presidential Group, various measures will be taken to bridge this gap including the introduction of a contractor forum and a consultant forum in regional and major conferences. In addition, a new policy will be implemented to encourage Corporate Associates to join and play a major role in some of the TCs.

- Embracing diversity and increasing wider participation: Under-represented groups (for reasons pertaining to geography, gender, ethnicity, etc.) deserve to be seen too. I would encourage all of you to embrace diversity. I will also be promoting improved representation in key roles on the ISSMGE Board, board-level committees, TCs, and in task forces and other ISSMGE activities including lecturing. Member societies will be asked to give the same attention to diversity.

- Reviewing all awards and honours lectures, and creating key lecturing opportunities for young members: The introduction of many new awards and honours lectures in 2013 has been well received. It is now time for us to review these awards and honours lectures to see if they indeed serve their original intents and purposes. Moreover, our young members are under-represented in major lectures. I would like to introduce Young Members Presidential Group (YMPG) lectures in different regional conferences. Young members are our future and must be given opportunities to learn and grow.

I alone cannot implement all of these initiatives. I would like to borrow a quote from Helen Keller, who was an American author, political activist, and lecturer. She said: "Alone we can do so little; together we can do so much." ("Seuls, nous pouvons faire si peu; ensemble, nous pouvons faire tellement")

I rely on your help in bringing these initiatives to fruition.

Albert Einstein once said that "The value of a man should be seen in what he gives and not in what he is able to receive." ("La valeur d'un homme devrait être vue dans ce qu'il donne et non dans ce qu'il peut recevoir")

This is something that I truly believe in, and it is with this attitude that I assume my role as the next President of the ISSMGE.

Charles W.W. Ng

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

5th International Course on Geotechnical and Structural Monitoring, 22 - 25 May 2018, in Rome www.geotechnicalmonitoring.com

EUROCK 2018 Geomechanics and Geodynamics of Rock Masses, 22-26 May 2018, Saint Petersburg, Russia, www.eurock2018.com/en

4th GeoShanghai International Conference, May 27-30, 2018, Shanghai, China, http://geo-shanghai.org

micro to MACRO - Mathematical Modelling in Soil Mechanics, May 29-June 1, 2018, Reggio Calabria, Italy, www.microtomacro2018.unirc.it

GeoReinforcement Workshop, 4 - 5 June 2018, Munich, Germany, https://igs.wufoo.com/forms/q10dk31u19dx00v/

International Conference on Deep Foundations and Ground Improvement - Urbanization and Infrastructure Development: Future Challenges, June 5-8, 2018, Rome, Italy, www.dfi.org/dfieventlp.asp?13310

GeoBarrier Workshop, 6 - 7 June 2018, Munich, Germany, https://igs.wufoo.com/forms/q10dk31u19dx00v/

XVI Danube-European Conference on Geotechnical Engineering: Geotechnical Hazards and Risks: Experiences and Practices, 7 - 9 June 2018, Skopje, Former Republic of Yugoslav www.decge2018.mk

16th European Conference on Earthquake Engineering (16thECEE), 18-21 June 2018, Thessaloniki, Greece, www.16ecee.org

CPT'18 4th International Symposium on Cone Penetration Testing, 21-22 June 2018, Delft, Netherlands, www.cpt18.org

PATA DAYS 2018 - 9th International INQUA Meeting on Paleoseismology, Active Tectonics and Archeoseismology, 24-29 June 2018, Chalkidiki, Greece, www.patadays2018.org

NUMGE 2018 9th European Conference on Numerical Methods in Geotechnical Engineering, 25-27 June 2018, Porto, Portugal, www.numge2018.pt

RockDyn-3 - 3rd International Conference on Rock Dynamics and Applications, 25-29 June 2018, Trondheim, Norway, www.rocdyn.org

ICOLD 2018 26th Congress – 86th Annual Meeting, 1 - 7 July 2018, Vienna, Austria, www.icoldaustria2018.com

9th International Conference on Physical Modelling in Geotechnics (ICPMG 2018), 17-20 July 2018, London, UK, www.icpmg2018.london

ICSSTT 2018 - 20th International Conference on Soil Stabilization Techniques and Technologies, July 19 - 20, 2018, Toronto, Canada, https://waset.org/conference/2018/07/toronto/ICSSTT

GeoChine 2018 - 5th GeoChina International Conference Civil Infrastructures Confronting Severe Weathers and Climate Changes: From Failure to Sustainability, July 23-25, , HangZhou, China, http://geochina2018.geoconf.org

UNSAT2018 The 7th International Conference on Unsaturated Soils, 3 - 5 August 2018, Hong Kong, China, www.unsat2018.org

China- Europe Conference on Geotechnical Engineering, 13-16 August 2018, Vienna, Austria, https://china-euro-geo.com

CRETE 2018 6th International Conference on Industrial & Hazardous Waste Management, 4-7 September 2018, Chania, Crete, Greece, www.hwm-conferences.tuc.gr

EUCEET 2018 - 4th International Conference on Civil Engineering Education: Challenges for the Third Millennium, 5-8 September 2018, Barcelona, Spain, http://congress.cimne.com/EUCEET2018/frontal/default.asp

SAHC 2018 11th International Conference on Structural Analysis of Historical Constructions "An interdisciplinary approach", 11-13 September 2018, Cusco, Perύ http://sahc2018.com

26th European Young Geotechnical Engineers Conference, 11 - 14 September 2018, Reinischkogel, Austria, www.tugraz.at/en/institutes/ibg/events/eygec

11th International Conference on Geosynthetics (11ICG), 16 - 20 Sep 2018, Seoul, South Korea, www.11icg-seoul.org

CHALK 2018 Engineering in Chalk 2018, 17-18 September 2018, London, U.K., www.chalk2018.org

International Symposium on Energy Geotechnics SEG - 2018, 25-28 September 2018, Lausanne, Switzerland https://seg2018.epfl.ch

HYDRO 2018 - Progress through Partnerships, 15-17 October 2018, Gdansk, Poland, www.hydropower-dams.com/hydro-2018.php?c_id=88

GEC - Global Engineering Congress Turning Knowledge into Action, 22 - 26 October, London, United Kingdom, www.ice.org.uk/events/global-engineering-congress

ARMS10 - 10th Asian Rock Mechanics Symposium, ISRM Regional Symposium, 29 October - 3 November 2018, Singapore, www.arms10.org

ACUUS 2018 16th World Conference of Associated research Centers for the Urban Underground Space "Integrated Underground Solutions for Compact Metropolitan Cities", 5 – 7 November 2018, Hong Kong, China, www.acuus2018.hk

International Symposium Rock Slope Stability 2018, 13-15 November, 2018, Chambéty, France, www.c2rop.fr/symposium-rss-2018

GeoMEast 2018 International Congress and Exhibition: Sustainable Civil Infrastructures, 24 - 28 November 2018, Cairo, Egypt, www.geomeast.org

WTC2019 Tunnels and Underground Cities: Engineering and Innovation meet Archaeology, Architecture and Art and ITA - AITES General Assembly and World Tunnel Congress, 3-9 May 2019, Naples, Italy, www.wtc2019.com

14th international Conference "Underground Construction", 3 to 5 June 2019, Prague, Czech Republic, www.ucprague.com

2019 Rock Dynamics Summit in Okinawa
7-11 May 2019, Okinawa, Japan
www.2019rds.org

We welcome you the 2019 Rock Dynamics Summit in Okinawa, a specialized symposium of the International Society for Rock Mechanics (ISRM) in Nago, Okinawa, Japan.

The First International Symposium on Rock Dynamics and Applications was held in Lausanne Switzerland in June 2013 and another international symposium on Rock Dynamics was held Suzhou China on May 2016, the next one will be held in Trondheim in June, 2018. 2019 Rock Dynamic Summit in Okinawa is a Specialized International Symposium of ISRM and jointly organized by the Rock Dynamics Committee of Japan (Japan Society of Civil Engineers) and Japanese and Turkish National Groups for Rock Mechanics (JSRM, TNGRM) under sponsorship of International Society for Rock Mechanics (ISRM).

Rock dynamics involves diverse research scopes ranging from earthquake engineering, blasting, impacts, failure as well as the occurrence and prediction of earthquakes. Rock dynamics has wide applications in civil and infrastructural, resources and energy, geological and environmental engineering, geothermal energy, and earthquake hazard management. This topic has become one of the important area of research and engineering activities in geomechanics and geoengineering. 2019 Rock Dynamic Summit in Okinawa is organized to address scientific research as well as engineering applications.

On behalf of the organizers of 2019 Rock Dynamic Summit in Okinawa, we look forward to meeting you in Nago, Okinawa, where to share and to cooperate, with a common goal to advance rock dynamics in April, 2019.

Themes

- Laboratory tests on Dynamic Responses of Rocks and Rock Masses; Fracturing of Rocks and Associated Strong Motions
- Estimation Procedures and Numerical Techniques of Strong Motions Associated with the Rupture of Earth's Crust and Some Strong Motion
- Dynamic Response and Stability of Rock Foundations, Underground Excavations in Rock, Rock Slopes Dynamic Responses and Stability of Stone Masonry Historical Structures and Monuments
- Induced Seismicity
- Dynamic Simulation of Loading and Excavation
- Blasting
- Rockburst, Outburst, Impacts
- Nondestructive Testing Using Shock Waves
- Case Histories of Failure Phenomenon in Rock Engineering

Contact Us

Please send the messages to the following address

Organizing Committee
E-mail: contact@2019rds.org

For Scientific issues, please contact

Prof. Dr. Ömer Aydan (Chair)
E-mail: aydan@tec.u-ryukyu.ac.jp
Assoc. Prof. Dr. Takafumi Seiki (Secretary)
E-mail: tseiki@cc.utsunomiya-u.ac.jp

VII ICEGE ROMA 2019 - International Conference on Earthquake Geotechnical Engineering, 17 - 20 June 2019, Rome, Italy, www.7icege.com

IS-GLASGOW 2019

7th International Symposium on Deformation Characteristics of Geomaterials
26 - 28 June 2019, Glasgow, Scotland, UK
https://is-glasgow2019.org.uk

The Technical Committee 101 of the ISSMEG is pleased to announce the organisation of the 7th International Symposium on Deformation Characteristics of Geomaterials (ISDCG) in 2019, in Glasgow, UK. The symposium is co-organised by the University of Strathclyde in Glasgow, the University of Bristol, and the Imperial College in London.

Building on the success of the previous Symposia organised in Sapporo (Japan) Japan in 1994, Torino (Italy) in 1999, Lyon (France) in 2003, Atlanta (US) in 2008, Seoul (Korea) in 2011 and Buenos Aires (Argentina) in 2015, the 7th ISDCG will equally follow both its traditions and active promotion of new technical elements to maintain it as one of the most popular and vibrant events within the geotechnical community. The technical core themes will focus on: (i) advanced laboratory geotechnical testing; (ii) application of advanced laboratory testing in research, site characterisation, and ground modelling; (iii) application of advanced testing to practical geotechnical engineering. In addition to these traditional topics, sub-themes will include cutting-edge techniques and approaches, for example experimental micro-mechanics, non-invasive monitoring systems, nano

and micro-sensors, new sensing technologies. A key goal is to engage with the full spectrum of geotechnical specialists, from early career engineers and researchers through to world leading experts.

Technical Core Themes

Advanced laboratory and field testing of geomaterials in saturated and unsaturated states

- Novel sensors for laboratory testing
- Advances in laboratory testing technique
- Digital image and PIV analysis
- Advances in ground investigation and field monitoring
- Geophysical methods
- Advanced sampling
- Particle-scale experimental observation
- Behaviour at geotechnical interfaces

From laboratory testing to constitutive and numerical modelling

- Constitutive modelling of geomaterials
- Numerical modelling of boundary value problems
- Physical modelling
- Anisotropy and localisation
- Time dependent responses (ageing, creep)
- Cyclic and dynamic behaviour
- Soil stabilisation (lime, cement, geopolymers, biopolymers, alkaline activation)
- Soil improvement via biological and chemical processes
- Thermal behaviour
- Frozen soils including hydrates
- Mixtures (soils with inclusions)
- Soil-plant interaction

Application of advanced testing to practical geotechnical engineering

- Integrated site characterisation
- Performance evaluation of geotechnical structures
- Field monitoring and observational method

cmn 2019 -Congress on Numerical Methods in Engineering, July 1 - 3, 2019, Guimarães, Portugal, www.cmn2019.pt

For additional information, please contact the secretariat of the congress, Ms. Lara Leite

CMN2019, Universidade do Minho, Departamento de Engenharia Civil, 4800-058 Guimarães - Portugal
Email: cmn2019@civil.uminho.pt
Telephone: +351 253 510 748
Fax: +351 253 510 217

The 17th European Conference on Soil Mechanics and Geotechnical Engineering, 1st - 6th September 2019, Reykjavik Iceland, www.ecsmge-2019.com

14th ISRM International Congress, 13-18 September 2019, Iguassu Falls, Brazil, www.isrm2019.com

XVII African Regional Conference on Soil Mechanics and Geotechnical Engineering
07-10 October 2019, Cape Town, South Africa

The South African Institution of Civil Engineering cordially invites all our colleagues from Africa and beyond to attend the 17th African Regional Conference on Soil Mechanics and Geotechnical Engineering.

Hosted in one of the continent's most iconic cities, this conference will serve practitioners, academics and students of all geotechnical backgrounds. The conference will take place at the Cape Town International Convention Centre (CTICC) offering world class conferencing facilities in the heart of South Africa's mother city and will offer extensive opportunities for Technical Committee Meetings, Workshops, Seminars, Exhibitions and Sponsorships. Exciting Technical Visits, including tours to the famous Robben Island, await.

The 7th African Young Geotechnical Engineers' Conference (8 – 10 October 2019) will commence on 8 October 2019, the day following the African Regional Conference (ARC) opening. The conference venue will be shared with the ARC delegates to initiate dialogue between junior and senior engineers while young geotechnical engineers acquaint themselves with the industry standards, new geotechnical developments and resources available to further their careers. The YGE conference provides an approachable audience within a vibrant environment where young presenters under the age of 35 are encouraged to exercise their presentation and technical writing skills on a continental platform.

Organiser: SAICE
Contact person: Dr Denis Kalumba
Email: denis.kalumba@uct.ac.za

XVI Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, 21 - 25 October 2019, Taipei, China www.16arc.org

XVI Panamerican Conference on Soil Mechanics and Geotechnical Engineering, 18-22 November 2019, Cancun, Quintana Roo, Mexico, http://panamerican2019mexico.com/panamerican

YSRM2019 - the 5th ISRM Young Scholars' Symposium on Rock Mechanics and REIF2019 - International Symposium on Rock Engineering for Innovative Future
1-4 December 2019, Okinawa, Japan

Contact Person: Prof. Norikazu Shimizu, jsrm-office@rocknet-japan.org

Nordic Geotechnical Meeting
27-29 May 2020, Helsinki, Finland

Contact person: Prof. Leena Korkiala-Tanttu
Address: SGY-Finnish Geotechnical Society,
Phone: +358-(0)50 312 4775
Email: leena.korkiala-tanttu@aalto.fi

EUROCK 2020
Hard Rock Excavation and Support
June 2020, Trondheim, Norway

Contact Person: Henki Ødegaard,
henki.oedegaard@multiconsult.no

6th International Conference on Geotechnical and Geophysical Site Characterization
07-09-2020 ÷ 11-09-2020, Budapest, Hungary
www.isc6-budapest.com

Organizer: Hungarian Geotechnical Society
Contact person: Tamas Huszak
Address: Muegyetem rkp. 3.
Phone: 0036303239406
Email: huszak@mail.bme.hu
Website: http://www.isc6-budapest.com
Email: info@isc6-budapest.com

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Why Quicksand Is A Nightmare For Civil Engineers

YouTuber Professional Engineering looks at how quicksand or soil liquefaction can destroy entire dams.

Teton Dam Failure, 1976

Constructing a dam requires a great deal of effort, they are a barrier meant to hold back torrents of water from either a lake or river. They are usually built using concrete or natural materials such as earth or rock. They are inspired by the engineering innovations of small furry forest creatures.

Over time, dams have been a significant aspect of water infrastructure and have evolved serve more than one purpose – Water supply, hydroelectric power, flood control, irrigation, and navigation.

Dams are built to withstand the incredible power of water, but there is one natural annoyance that can lead to dangerous conditions and the eventual erosion of a dam. Quicksand. This is a topic YouTuber Professional Engineering explores in his video titled, "How Quicksand Causes Dam Failures."

How Quicksand Causes Dam Failures
https://www.youtube.com/watch?v=eImtYyuQCZ8

Once thought of as a foil for Indiana Jones and the Princess Bride, this "puddle of mud" is very real for civil engineers, who often battle this "quick condition" when constructing a dam. Something that is often considered when building a dam is Darcy's Law, which was named after a French hydraulics expert from the 1800s. Darcy's Law is "an equation that defines the ability of a fluid to flow through a porous media such as rock."

Darcy's Law is something engineers generally try to avoid when building a dam. If you're building a dam, you're constructing it on the millions of tiny fragments that make up soil, all held together by a gravitational force and friction. Water and friction don't go together, and we all know that water is a huge component of dam building.

Teton Dam

Water can seep its way through the soil fragments, pushing them apart and weaken the infrastructure. This can cause significant disasters such as the Teton Dam Flood which resulted from the massive collapse of the earthen Teton Dam. The disaster killed eleven people, destroyed thousands of homes, businesses and wiped out entire agricultural communities in the area. The cost of damage was estimated to be $2 billion at the time, close to $9 billion now.

Teton Dam Failure, Teton River, Idaho, June 5, 1976
https://www.youtube.com/watch?v=b6NAjrIjf3U

The cause of the collapse was found to be the hydraulic piping or internal erosion caused by water seeping through the soil, weakening the overall structure. Darcy's Law at work.

So to prevent this, engineers dig walls below the surface to slow down Darcy's Law and soil liquefaction or in layman's terms, when soil behaves like water. This is quicksand.

"It's just one of the complex failure modes that civil engineers must consider when designing a structure that might interact with water, the great eroder," writes Professional Engineering on his blog.

One common way to deal with seepage is a cut-off wall, "Typically, the method involves installing a very low permeability physical cut-off wall or barrier around the perimeter of the excavation to prevent groundwater from entering the working area," explains Groundwater Engineering.

Beavers make it all look so easy.

(Danielle De La Bastide / INTERESTING ENGINEERING, October, 01st 2017, https://interestingengineering.com/why-quicksand-is-a-nightmare-for-civil-engineers)

The Future of Tunnelling

The Changing Face of the Tunneling Industry: The Role of the ITA, Partnership, and Innovation

Martin Knights graduated with a degree in Civil Engineering in 1970 and joined the Second River Mersey Road tunnel project as a site engineer in Liverpool, UK as his first TBM project. The major feature of this 2.5 mile long twin tunnel project was the refurbished 35 ft diameter Robbins TBM, which had previously driven a number of water supply tunnels at the Mangla Dam in Pakistan. Knights worked in several consultancy firms on a number of high profile tunnelling projects over several decades, most recently as the Managing Director and Sr. Vice President for CH2M/Halcrow. He was also president of the International Tunnelling Association (ITA) from 2007-2010. He is currently an independent consultant with his own company, Martin Knights Consulting.

At the recent ITA Training Course in Bergen, Norway, which preceded the World Tunnel Congress, I gave a lecture about the development of Soft Ground TBMs from Victorian times until now. It took a bit of research: I trawled through reference books and talked to experts in the TBM world. During the research I looked at project specifications for big projects carried out in the past 40 or so years, and was struck by the level of technical detail and requirements that engineers stipulated in the contract documents: there seemed to be a tendency for over-specification that imprisoned the contractor and his equipment suppliers to past tried-and-tested practices. Where was the opportunity to innovate

and trial new ideas by those best suited to introduce best and new practices?

That reminded me of Lok Home's [Robbins president] challenge to me in November 2009 at the Hamburg, Germany STUVA Exhibition and Conference. Lok and I, and other colleagues in ITA and the tunnelling world, took part in an industry round table talk. I was President of ITA then and the two-hour discussion concluded with Lok asking me, "So, Martin, what can I and the industry do for ITA? We provide sponsorship to ITA, like other leading tunnelling companies; we fill the exhibition halls; we host social gatherings during ITA conferences, and we give lectures promoting new products. But we as equipment manufacturers and suppliers want to play a bigger technical role."

Stung by the realisation that ITA had, by default, missed a trick, and was, in effect, excluding the very talent that provided innovation in tunnelling, I set about forming the then-new ITA technical forum ITAtech. I say "I", but in fact myself, Lok, Tom Melbye of Normet, Felix Amberg of Amberg Engineering, and colleagues from Herrenknecht, Mapei, Atlas Copco, and others set out over three months to prepare the ground to launch ITAtech as a premier promoter within ITA of technology and innovation. Our purpose was to prepare independent and commonly-agreed technical guidelines and evidence endorsed by the whole international tunnelling industry, which is what ITAtech continues to do. It provides manufacturing, installation, equipment and materials guidelines for Contractors and Designers and creates confidence for tunnel owners that the "brand" of the ITA is overseeing this important knowledge transfer.

The initial 2009 meeting that led to the ITAtech forum. Left to right: Bill Hansmire, Gerhard Robeller, Olivier Vion, Gunnar Nord, Martin Knights, Brian Fulcher, Pekka Nieminen, Lok Home, David Caiden, Daniel Ruckstuhl

As I talked to the Bergen delegates this year, it was obvious to me that soft ground urban tunnelling owes a debt to the development of TBMs over the past 40 years…and particularly to the past 10 years. We can now do things that were too difficult to do way back then. It's no coincidence that the innovations in the last 50 years were led by TBM companies like Robbins, Lovat, Seli, Herrenknecht, etc. The leadership and pioneering spirit could have only been driven by the individual passion that comes from a "family run" business. With time, growth and ownership has been passed on, but the stewardship and spirit of innovation in tunnelling lives on. ITAtech has tried to capture that spirit. Membership of its Steering Board and Activity groups relies on that desire of industry to educate, improve and share.

A recent President of the UK Institution of Civil Engineers compared our fragmented industry processes with the manufacturing, aircraft and car industry. In effect he said "Why–unlike those industries–do we separate inception, planning, and design from assembly, installation and construction?" The infrastructure and mining industries rely on so many processes and partnerships to deliver projects precisely because they are so fragmented and siloed.

Contemporary procurement encourages more partnerships, but this doesn't make it any less convoluted. We see the rise of the dreaded words "industry supply chain" and "second and third tier partners", where it strikes me that we're airbrushing out the identity of the very "tier" of industry that has to innovate and provide the substance that nourishes the technical solutions that feature in new infrastructure developments.

I suggest that owners and clients get better access to and value from these innovating "tiers"—in many cases the equipment manufacturers and suppliers. In so many cases I have seen technical solutions get misinterpreted as ideas and solutions move up and down the so-called supply chain, begging for recognition, understanding and realisation of value.

I'm sure that this is not intended…but it happens. By validating and bringing innovations to the forefront through organizations like the ITAtech, we can improve some of the convoluted procurement and technical approval processes. However if we want to continue to see advancements like we've seen in urban soft ground tunnelling in recent decades, we should seek to streamline manufacturing and procurement, and to work closely with all "tiers" involved—second, third, and on up.

(Martin Knights / Robbins website, 13/10/2017, http://tunnelbuilder.com/News/The-future-of-tunnelling-Martin-Knights.aspx)

Why did the 2014 Oso landslide travel so far?

On Saturday, March 22, 2014, a devastating landslide roared across the North Fork of the Stillaguamish River, near Oso, Washington. The landslide killed 43 people as it plowed through the Steelhead Haven neighborhood. When it stopped, after crossing the river, the neighborhood, and State Route 530, the Oso landslide had traveled 1.4 km (0.86 miles).

That's a remarkable distance, says Brian Collins of the USGS, given the geologic and geographic context. On Tuesday, October 24, 2017, at the GSA Annual Meeting in Seattle, Collins and co-author Mark Reid presented the results of mapping that will help explain how the Oso landslide moved so far across the valley.

Oblique aerial photograph of the Oso, Washington landslide, showing the entire extent of the landslide source area and path. Credit: Mark Reid, USGS.

In addition, Collins says, the work may also help settle debate over the mobility sequence of the landslide, and

whether it moved as two sequential slides, or as one. "Our observations suggest it moved as one landslide," he says.

To explore the landslide's mobility, Collins and Reid focused on hummocks deposited during the landslide. Hummocks are intact blocks of landslide debris that have been transported from their source area. The Oso hummocks, as tall as 20 m (65 feet), cover 0.6 km^2 (0.23 mi^2), burying the former site of Steelhead Haven. They consist of blocks of horizontally layered glacial deposits, often complete with the overlying forest floor. In numerous cases, trees and ferns remained upright and alive as they were rapidly transported south during the landslide.

"Hummocks can show the style of motion that the landslide underwent once initiated," explains Collins. "At Oso, we were able to reconstruct the mechanism under which the source area turned into the deposit by manually digging into the landslide about 1 500 times in order to identify the materials forming the hummocks." That work revealed that the hummocks were rafted across the valley on a liquefied base layer.

Collins presented what the USGS has learned about the 2014 Oso landslide, including the liquefied base layer, the intact hummock blocks, and hundreds of telltale liquefaction features such as sand boils that give evidence of the high pore pressures at the base of the slide.

In the next talk, Reid will share detailed descriptions and discuss implications of the hummocks and liquefaction features mapped within the hummock field. Those features include "slosh pits" and sand boils, some of which erupted through over seven meters of deposits. The team mapped these features within months of the slide. A year later, the liquefaction features had disappeared, erased by erosion and new vegetation.

Source: The Geological Society of America

(Steven Young / The Watchers, October 24, 2017, https://watchers.news/2017/10/24/why-did-the-2014-oso-landslide-travel-so-far/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Σε ανθρώπινες δραστηριότητες ίσως οφείλονται 728 σεισμοί παγκοσμίως
Έξι από αυτούς στην Ελλάδα

Η δημιουργία της τεχνητής λίμνης Κρεμαστών φαίνεται ότι προκάλεσε το 1966 σεισμό 6,2 Ρίχτερ

Σε 728 εκτιμώνται οι καταγεγραμμένοι σεισμοί στον πλανήτη μας, οι οποίοι κατά τα τελευταία 150 χρόνια μπορεί να οφείλονται σε διάφορες ανθρώπινες δραστηριότητες και όχι σε καθαρά φυσικά αίτια. Από αυτούς, οι έξι φέρονται να έχουν συμβεί στην Ελλάδα, όλοι στο πλαίσιο δημιουργίας φραγμάτων και τεχνητών λιμνών.

Οι γεωεπιστήμονες που είναι υπεύθυνοι για τη «Βάση Δεδομένων Ανθρωπογενών Σεισμών» (**HiQuake**), την πιο πλήρη του είδους της διεθνώς, έκαναν τη σχετική ανακοίνωση στο περιοδικό Seismological Research Letters, της Σεισμολογικής Εταιρείας της Αμερικής.

Σύμφωνα με τα τελευταία στοιχεία, οι τρεις κυριότερες αιτίες πρόκλησης σεισμών είναι οι εξορυκτικές-μεταλλευτικές δραστηριότητες (37% - συχνά εξαιτίας της κατάρρευσης στοών), η δημιουργία μεγάλων φραγμάτων νερού (23%) και οι συμβατικές μέθοδοι άντλησης πετρελαίου και αερίου (15%).

Άλλες αιτίες είναι οι δραστηριότητες γεωθερμικής ενέργειας (8%), οι υπόγειες πυρηνικές εκρήξεις (3%), ακόμη και η ανέγερση μεγάλων ουρανοξυστών που ασκούν μεγάλο βάρος στο υπέδαφος (0,5%). Όχι αμελητέοι (4%) είναι επίσης οι σεισμοί εξαιτίας αντισυμβατικών μεθόδων άντλησης πετρελαίου και φυσικού αερίου με χρήση της τεχνικής της υδραυλικής ρωγμάτωσης (εισροή νερού με μεγάλη πίεση σε υπόγεια ρήγματα).

Η βάση δεδομένων Human-Induced Earthquake Database (HiQuake), αναπτύχθηκε το 2016 από βρετανούς επιστήμονες των Πανεπιστημίων Ντάραμ και Νιούκαστλ, με επικεφαλής τον υδρογεωλόγο Μάιλς Ουίλσον. Οι επιστήμονες βασίσθηκαν τόσο σε επιστημονικές μελέτες, όσο και σε αναφορές των μέσων ενημέρωσης. Ο παλαιότερος ανθρωπογενής σεισμός που περιλαμβάνει η βάση δεδομένων, είναι από το 1868 στην Αυστραλία και αποδίδεται σε εξορυκτική δραστηριότητα.

Οι περισσότεροι ανθρωπογενείς σεισμοί είναι μικροί της τάξης των τριών έως τεσσάρων βαθμών, αλλά ορισμένοι είναι πολύ ισχυροί. Ο ισχυρότερος σεισμός που περιλαμβάνεται στη βάση δεδομένων, είναι αυτός ισχύος 7,9 βαθμών, ο οποίος προκλήθηκε στην περιοχή Σιτσουάν της Κίνας το 2008 πιθανώς λόγω της δημιουργίας ενός μεγάλου φράγματος νερού σε απόσταση λίγων χιλιομέτρων από το επίκεντρο. Αλλά και ο πιο πρόσφατος καταστροφικός σεισμός στο Νεπάλ ισχύος 7,8 βαθμών το 2015 αποδόθηκε από ορισμένους επιστήμονες στην άντληση υπόγειων υδάτων.

Συχνά, προϋπάρχει τεκτονικό στρες προερχόμενο από φυσικές γεωλογικές δυνάμεις και η ανθρώπινη δραστηριότητα αποτελεί την τελευταία σταγόνα στο ποτήρι, που «πυροδοτεί» το σεισμό. Εξίσου συχνή όμως είναι η διαφωνία ειδικών και μη κατά πόσο ένας σεισμός οφείλεται (και) στους ανθρώπους. Οι ίδιοι οι δημιουργοί της HiQuake αναγνώρισαν πως είναι πολύ δύσκολο να υπάρχει σαφής απόδειξη ότι όντως ένας σεισμός οφείλεται στους ανθρώπους, αν και αυτό, όπως είπαν, δεν πρέπει να μας καθησυχάζει.

Στην Ελλάδα, σύμφωνα με τη διεθνή βάση δεδομένων, έχουν πιθανώς γίνει έξι σεισμοί σχετιζόμενοι με την ανθρώπινη δραστηριότητα, όλοι στο πλαίσιο της δημιουργίας φραγμάτων και αντίστοιχων τεχνητών λιμνών που συγκρατούν μεγάλους όγκους νερού: Μαραθώνα (1938 - 5,7 βαθμοί), Κρεμαστών Αιτωλοακαρνανίας-Ευρυτανίας (1966 - 6,2 βαθμοί), Καστρακίου Αιτωλοακαρνανίας-Αχελώου (1969 - 4,6 βαθμοί), Πουρναρίου Άρτας-Αράχθου (1981 - 5,6 βαθμοί), Ασωμάτων Βέροιας (1984 - 5,4 βαθμοί) και Πολυφύτου Κοζάνης-Αλιάκμονα (1995 - 6,5 βαθμοί - ο ισχυρότερος ανθρωπογενής σεισμός στη χώρα μας).

«Όλες οι ανθρωπογενείς δραστηριότητες επηρεάζουν τις δυνάμεις που δρουν στο φλοιό της Γης, για παράδειγμα προσθέτοντας ή αφαιρώντας μάζα, συνεπώς δεν πρέπει να μας εκπλήσσει ότι η Γη αντιδρά σε αυτές τις αλλαγές, μερικές φορές με πρόκληση σεισμών», δήλωσε ο Ουίλσον.

Σύμφωνα με τις εκτιμήσεις του, θα πρέπει να αναμένεται αύξηση των ανθρωπογενών σεισμών στο μέλλον, καθώς οι πιέσεις στη Γη εκ μέρους των ανθρώπων θα αυξηθούν, π.χ. λόγω της εντεινόμενης αναζήτησης και αξιοποίησης της υπόγειας γεωθερμικής ενέργειας ή της μελλοντικής υπόγειας αποθήκευσης του διοξειδίου του άνθρακα, για να μην επιβαρύνει ως «αέριο του θερμοκηπίου» την κλιματική αλλαγή.

Επίσης, τα ορυχεία τείνουν να φθάνουν όλο και βαθύτερα και να είναι όλο και πιο εκτεταμένα, τα μεγάλα φράγματα νερού γίνονται όλο και συχνότερα, ενώ κτίζονται όλο και μεγαλύτερα κτίρια σε διάφορα μέρη του κόσμου λόγω της αύξησης του παγκόσμιου πληθυσμού.

(health.in.gr, ΑΠΕ-ΜΠΕ, 4 Οκτ. 2017, http://news.in.gr/science-technology/article/?aid=1500165389)

HiQuake: The Human-Induced Earthquake Database

M. P. Wilson, G. R. Foulger, J. G. Gluyas, R. J. Davies, B. R. Julian

ABSTRACT

HiQuake—The Human-Induced Earthquake Database is the most complete database of anthropogenic projects proposed, on scientific grounds, to have induced earthquake sequences. It is freely available to download from the website given in Data and Resources. At the time this article was written, *HiQuake* contained ~730 anthropogenic projects proposed to have induced earthquakes, as well as associated project-related and seismic data. The most commonly reported anthropogenic activities proposed to have induced earthquakes are mining and water reservoir impoundment. In recent years, the number of earthquake sequences proposed to have been induced by fluid-injection activities has grown. The most commonly reported maxi-

mum observed magnitude in an induced earthquake sequence is $3 \leq M_{MAX} < 4$. The largest earthquake in *HiQuake* proposed to have been induced had a magnitude of M_w 7.9 and occurred in China. Such large earthquakes release mostly stress of natural tectonic origin, but are conceivably triggered by small anthropogenic stress changes. The data in *HiQuake* are of variable quality because they are drawn from publications that span almost a century. We estimate underreporting to be ~30% for M~4 events, ~60% for M~3 events, and ~90% for M~2 events. The degree of certitude that the given earthquake sequences were anthropogenically induced is variable. *HiQuake* includes all earthquake sequences proposed on scientific grounds to have been human induced without regard to the strength of the case made. *HiQuake* is offered freely as a resource to interested parties, and judging the reliability of any particular case is the responsibility of the database user. *HiQuake* will be routinely updated to correct errors, update existing entries, and add new entries. It has the potential to help improve our understanding of induced earthquakes and to manage their impact on society.

Seismological Research Letters (2017) 88 (6): 1560-1565.
DOI: https://doi.org/10.1785/0220170112
Published: October 04, 2017
https://pubs.geoscienceworld.org/ssa/srl/article-abstract/88/6/1560/519166/hiquake-the-human-induced-earthquake-database?redirectedFrom=fulltext

Researchers Say They've Invented 'Earthquake-Proof' Concrete

Researchers from the University of British Columbia have developed a new material that may help make buildings earthquake-proof. The product is made of polymer and fly ash.

The EDCC getting sprayed on a block wall in the UBC lab.

Earthquakes have the ability to destroy buildings quickly and comprehensively with a devastating loss to human life. Engineers and architects around the world dedicate their lives to finding ways to 'earthquake proof' buildings for construction in earthquake-prone areas.

Researchers from the University of British Columbia developed a new type of 'concrete' that has ductile properties, allowing it to bend rather than break under pressure. Concrete is one of the most popular building materials around the world. It's relatively cheap, quite easy to work with, has a long life and is resistant to fire. However, it's very vulnerable to the stresses caused by seismic events. The production of concrete is also very damaging to the environment. One of its main ingredients is cement. Cement has its own issues, as the team from UBC noted in their research.

"The cement industry produces close to seven percent of global greenhouse gas emissions," says UBC Professor Nemy Banthia.

The new material called EDCC solves both the structural and environmental problems of traditional concrete. EDCC replaces almost 70 percent of the cement normally used to make concrete with fly ash. Fly ash is a byproduct from burning pulverized coal in electric power generating plants. It's created during combustion when mineral impurities in the coal fuse in suspension and float out of the combustion chamber with the exhaust gases. It can then be captured and used for other purposes.

The reduction in the use of cement address one of the most relevant environmental problems for the construction industry. Banthia says, "By replacing nearly 70 percent of cement with fly ash, we can reduce the amount of cement used. This is quite an urgent requirement, as one tonne of cement production releases almost a tonne of carbon dioxide into the atmosphere."

EDCC is also created using polymer-based fibers that provide its flexibility and strength. The final product is more like steel than concrete. Most importantly, unlike existing building materials, it is extremely ductile. This means it can warp and bend when under pressure rather than crack, crumble or twist like concrete and steel do. The CBC Researchers sprayed a 10 mm layer of EDCC onto concrete block walls before putting the walls under a simulated stress

similar to the magnitude 9 earthquake, that struck Tohoku, Japan in 2011. The same pressure was placed onto a regular unreinforced block wall which collapsed at about 65 percent intensity of the Japanese quake.

Luckily for us, EDCC isn't just a prototype. It has been developed into a commercial read-product that has been awarded as an official seismic retrofit option in British Columbia, Canada. For many retrofit projects, EDCC will not only make sense from a strength point of view but will also be more cost-effective than traditional methods of steel bracing. It is currently being installed into a local primary School in Earthquake risk area, Vancouver. The researchers hope to also use EDCC in seismic retrofits in areas in Northern India which experience a lot of seismic activity.

(Jessica Miley / INTERESTING ENGINEERING, October, 13th 2017, https://interestingengineering.com/researchers-say-theyve-invented-earthquake-proof-concrete?_source=newsletter&_campaign=a4ZyM1Mpa9X9o&_uid=9wdL9JEwej&_h=9480fc0933eb231a0575c535417bef075ed6e805&utm_source=newsletter&utm_medium=mailing&utm_campaign=Newsletter-13-10-2017)

Giant tsunami reshaped California coastline

New evidence suggests a gigantic tsunami hit the California coast 900 years ago, removing three to five times more sand than any El Niño storm in history. Since large tsunamis hit the northwestern US every 300 to 500 years and the last occurred in January 1700, another could happen anytime in the next 200 - 300 years.

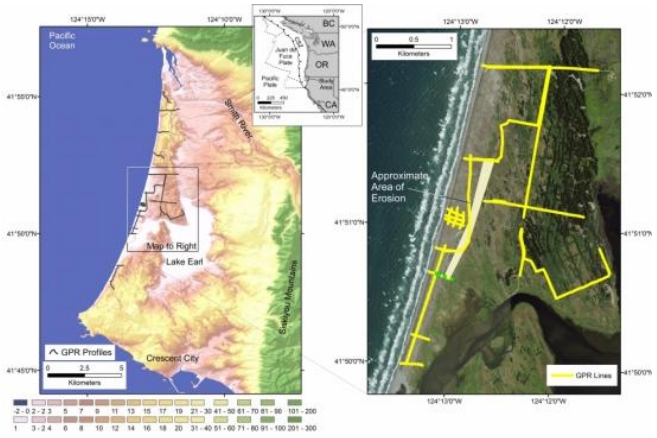
"We found a very distinct signature in the GPR [ground penetrating radar] data that indicated a tsunami and confirmed it with independent records detailing a tsunami in the area 900 years ago," explains Alexander Simms, an associate professor at the University of California, Santa Barbara's earth science department and Earth Research Institute, and a lead author of a new study published in Marine Geology.

"By using GPR, we were able to see a much broader view of the damage caused by that tsunami and measure the amount of sand removed from the beach."

According to Simms, the magnitude and geography of that epic wave were similar to the one that occurred in Japan in 2011. Geologic records show that these large tsunamis hit the northwestern United States (Northern California through Washington state) every 300 to 500 years. The last one occurred in January 1700, which means another tsunami could happen anytime in the next 200 to 300 years.

"People have tried to figure out how far inland these waves hit, but our analysis provides concrete evidence of just how far inland the coast was eroded," Simms says. "Any structures would not only have been inundated, they would have been eroded away by the tsunami wave."

When a tsunami recedes from land, it removes sand and reshapes the coastline. In the case of the event 900 years ago, the beach was eroded more than 1.8 m (6 feet) down and more than 110 m (360 feet) inland.



Digital elevation model and aerial photograph of the study area illustrating the location of the ground-penetrating radar profiles. Credit: UC Santa Barbara

"That's a big wedge of sand that moved from the beach," Simms explains. "But because there is so much sand in the system along the coast right after a tsunami, the beach heals pretty quickly on geological timescales. Some of the sand returns from being taken out to sea by the tsunami, but some comes from river catchments that deliver additional sand to the beach as a result of the concomitant earthquake."

While the erosional scar can heal rather quickly, Simms notes, initially the coast is reshaped due to newly formed channels, cuts, and scarps. Once the beach fills in, he adds, the coastline straightens and returns to what it looked like prior to the tsunami. The paper demonstrates this process after the December 26, 2004 Sumatra tsunami, with satellite imagery from before the event, one month after, and four years later.

"The important thing to remember is that these tsunamis can erode the beach up to 360 feet inland," Simms says. "That means you have to be far inland to be safe when one of them occurs."

Reference:

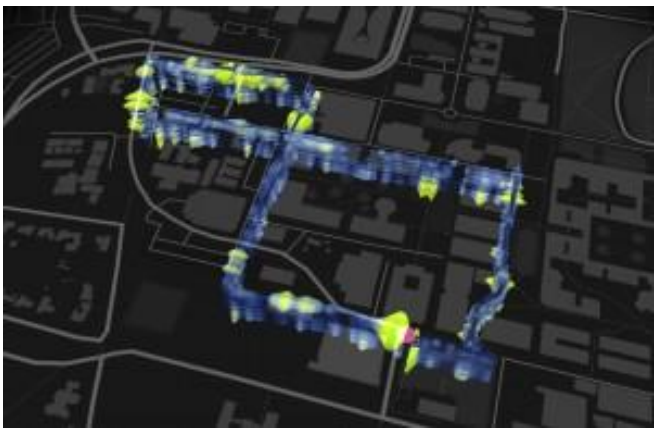
"Coastal erosion and recovery from a Cascadia subduction zone earthquake and tsunami" - Alexander R. Simms et al. - Marine Geology (2017) - https://doi.org/10.1016/j.margeo.2017.08.009

Written by Julie Cohen - UC Santa Barbara

(Steven Young / the watcers, October 17, 2017, https://watchers.news/2017/10/17/giant-tsunami-reshaped-california-coastline/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

Researchers Use Fiber Optic Technology to Track Earthquakes

A team at Stanford University are currently using a fiber optic network underneath their campus, to sense oncoming earthquakes.



Map shows location of a 3-mile, figure-8 loop of optical fibers installed beneath the Stanford campus as part of the fiber optic seismic observatory. Image credit: Stamen Design and the Victoria and Albert Museum Stanford News Service

Over the last year, earthquakes wreaked havoc on various parts of the world. Central and Southwest Mexico experienced a devastating natural disaster when an earthquake reaching a magnitude of 7.1 that pummelled Mexico City and killed hundreds of people.

As the quakes are growing in strength, scientists rush to find innovative ways to sense the earliest rumbles of a giant earthquake. Recently, researchers at Stanford University are using optical fibers that generally transmit data, such as high-speed internet and HD video, to also observe what is happening around them, including seismic activity.

Biondo Biondi, a professor of geophysics at Stanford's School of Earth, Energy & Environmental Sciences, has been working with a 4.8 kilometer (or 3-mile) test loop of optical fibers installed on the University campus to record vibrations caused by earthquakes in the area.

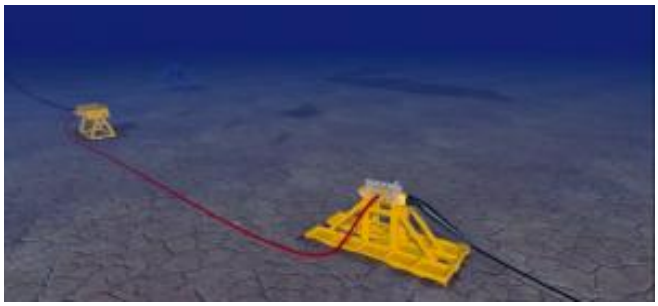
Optical fibers are human hair sized strands of pure glass which are normally bundled together to create cables which transmit data signals over long distances, which convert these electronic signals into light.

So far, Biondo and his team have recorder 800 seismic events using this fiber optic system with instruments called laser interrogators provided by the company *OptaSense,* which is a co-author on publications about the research. Since September 2016; they've noted signals from the Mexican earthquake and vibrations from quarry blasts in the area.

"As expected, both earthquakes had the same waveform, or pattern, because they originated from the same place, but the amplitude of the bigger quake was larger," Biondi said. "This demonstrates that fiber optic seismic observatory can correctly distinguish between different magnitude quakes."

The fibers can distinguish between two types of earthquake waves by classifying them as P waves and S waves. P waves travel faster, and S waves cause more damage.

A Fiber optic sensory system isn't a new technology; many oil and gas companies use it as a standard operating procedure, called DAS or distributed acoustic sensing.



Source: Undersea Fiber Optic Cable Connection/YouTube/SubCom Channel

"How DAS works is that as the light travels along the fiber, it encounters various impurities in the glass and bounces back," said Eileen Martin, a graduate student on the project in a statement. "If the fiber were totally stationary, that 'backscatter' signal would always look the same. But if the fiber starts to stretch in some areas — due to vibrations or strain — the signal changes."

Though, the difference between the energy sector's process and Biondi's involves stabilization. Oil and gas usually attach fibers to a surface area of a pipeline or by solidifying them in cement. Biondi however, used free-floating fiber optic cables laying inside plastic piping, similar to a standard optical communications installation.

Both stabilized, and free systems work by taking advantage of these innate impurities in optical fibers.

Dubbed the fiber optic seismic observatory, researchers claim the system is also cheaper to run. Currently, the only equipment used to monitor earthquakes are seismometers, while they are more sensitive than Biondi's telecom array, their coverage is sparse and can be expensive to both install and maintain.

"Every meter of optical fiber in our network acts as a sensor and costs less than a dollar to install," Biondi said. "You will never be able to create a network using conventional seismometers with that kind of coverage, density, and price."

The observatory is still a long way from developing a city-wide seismic network, as there are still bureaucratic hurdles to overcome, such as proving the array can operate within a cities infrastructure.

(Danielle De La Bastide / Interesting Engineering, October, 22nd 2017, https://interestingengineering.com/researchers-use-fiber-optic-technology-to-track-earth-quakes?_source=newsletter&_campaign=1EnEnKZgQgJa4&_uid=9wdL9JEwej&_h=9480fc0933eb231a0575c535417bef075ed6e805&utm_source=newsletter&utm_medium=mailing&utm_campaign=Newsletter-22-10-2017)

UK engineers develop device for earthquake-proofing buildings

UK developed structural engineering technology could protect buildings from the impact of earthquakes or blasts, preventing collapse and reducing the damage caused.

Developed by a group at Heriot-Watt University in Edinburgh, the system makes use of stainless steel 'sacrificial devices' which are placed strategically in the structure so that they are the only damaged components during earthquake loading.

Current European 'earthquake-proof' buildings were designed to prevent collapse in the event of a strong earthquake. However, they do not prevent extensive damage that is difficult to repair, or the permanent deformation of a building after it has stopped shaking (also known as residual drift). Typically, If buildings experience one or both of these factors, the cost of repairs can become prohibitive, and demolition may be the only viable option.

The aftermath of the 2011 New Zealand earthquake

Dr George Vasdravellis, assistant professor in structural engineering at Heriot-Watt University in Edinburgh, has used computer simulations to prove that his new system minimises the damage caused to buildings up to 10 storeys high in an area of high seismicity, with one in 475-year seismic events.

"The inherent properties of stainless steel results in the significant reduction of the residual drifts after a strong earthquake," said Vasdravellis. "Through experimental testing and numerical simulations, we found that our system had negligible residual drifts under loading corresponding to the 'design earthquake', compared to conventional building designs, which experienced drifts that were four to five times larger."

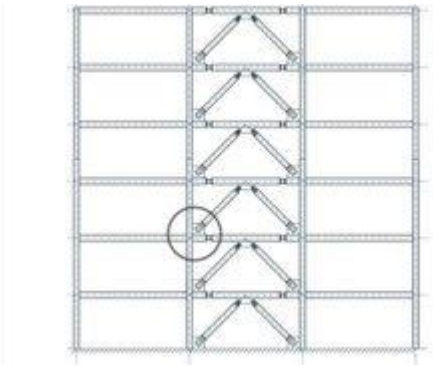
Vasdravellis said the that after a strong seismic event the device could simply be replaced, dispensing with the need to demolish the building. The technology could even be retrofitted to existing buildings he added: "In Greece and Italy, we've watched new areas become seismic, where previously there had been little activity. We must also consider, unfortunately, the impact of explosions or other attacks on buildings that could impose extreme loading conditions"

He and his team are now working with £140,000 of European Commission funding to take the technology to the next stage and adapt it for taller buildings.

(25th October 2017, https://www.theengineer.co.uk/uk-device-earthquake-proofing/?cmpid=tenews_4180421&adg=767376ef-22e9-42c2-b1d3-e4762727e8f9)

Structural engineers raise the bar in earthquake resistance

Engineers at Heriot-Watt University have designed a 'sacrificial device' for buildings that absorbs the impact of earthquakes or explosions to prevent or reduce damage.



Sacrificial braces reduce damage

The inventors say that their steel frame design could not only prevent collapse but also reduce the damage and residual drifts that can render buildings uninhabitable in the event of a quake or blast.

Current European 'earthquake-proof' buildings are designed to prevent collapse in the event of a strong earthquake. However, they do not prevent extensive damage that is difficult to repair, or residual drifts. If buildings experience one or both of these factors, the cost of repairs can become prohibitive, and demolition becomes the only viable option.

George Vasdravellis, assistant professor in structural engineering at Heriot-Watt University in Edinburgh, has used experimental testing and computer simulations to demonstrate that his new system minimises the damage caused to buildings up to 10 storeys high in an area of high seismicity, with one in 475-year seismic events.

Now, he and his team are adapting the design for taller buildings to ensure that their minimal-damage steel frame

design will address the disadvantages of conventional building design.

Dr Vasdravellis said: "The non-repairable damage and residual deformations that conventionally-designed buildings experience after a seismic event represent a severe socio-economic loss. We need new methods of resilience to tackle this issue.

"We have developed an innovative steel frame that could achieve high seismic resilience, structural and non-structural damage control, and minimise residual deformations.

"The system makes use of 'sacrificial devices' made of stainless steel material. The devices are placed strategically in the structure, so that they are the only damaged components during earthquake loading.

"In the aftermath of a strong seismic event, they can be easily replaced with new ones, so that the building can return to its usual occupation very quickly."

He added: "The inherent properties of stainless steel results in the significant reduction of the residual drifts after a strong earthquake. Through experimental testing and numerical simulations, we found that our system had negligible residual drifts under loading corresponding to the 'design earthquake', compared to conventional building designs, which experienced drifts that were four to five times larger."

The ability to retrofit the device and make it commercially viable for architects and construction firms is at the forefront of Dr Vasdravellis's mind.

"In Greece and Italy, we've watched new areas become seismic, where previously there had been little activity. We must also consider, unfortunately, the impact of explosions or other attacks on buildings that could impose extreme loading conditions," he said.

"The sacrificial devices will mitigate progressive collapse due to explosions, or other extreme events, that result in the loss of one or more columns in the building. Therefore, we are further developing the system for multi-hazard mitigation."

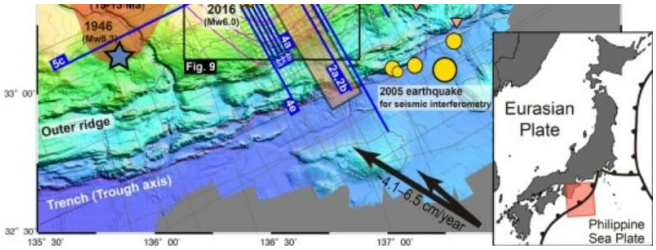
He concluded: "It is not enough to 'earthquake-proof' new buildings; we need simple, effective devices like this that can protect our existing built environment and heritage, minimising damage and costs in the event of a seismic event or blast."

Dr Vasdravellis has been awarded £140,000 by the European Commission for the next stage of his research into earthquake engineering.

(25th October 2017,
http://www.theconstructionindex.co.uk/news/view/structural-engineers-raise-the-bar-in-earthquake-resistance)

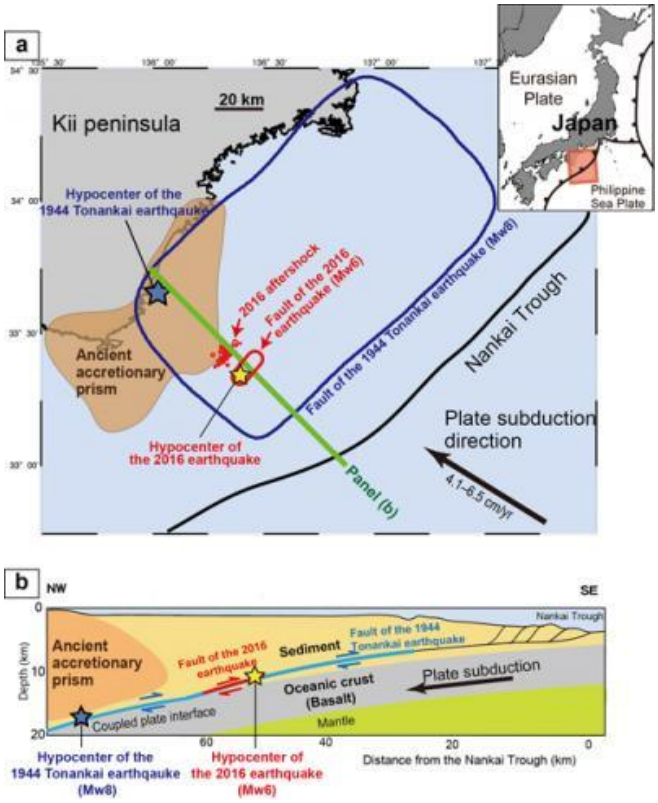
Japanese earthquake zone strongly influenced by the effects of friction

Kyushu University-led researchers identified strong influence of pre-existing fault and plate structure on earthquake location and behavior in the Nankai Trough offshore of Japan.



The islands of the Japanese archipelago are affected both by frequent, low-magnitude earthquakes and tremors and by larger, highly destructive events. One of the largest quakes to strike Japan occurred in 1944, leading to the loss of more than 1 200 lives on the main and most populated island of Honshu.

Its strength resulted from the abrupt release of plate tectonic forces, a process known as subduction, centered on an area beneath Honshu where it slides over the top of the oceanic crust.



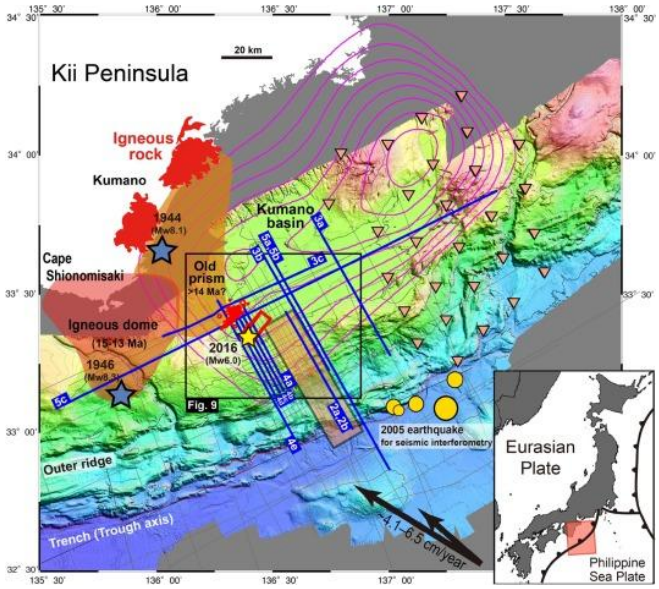
(a) This is a location map showing fault planes of the 2016 earthquake (red) and the 1944 Tonankai earthquake (blue). Yellow and blue stars indicate the hypocenters of the 2016 earthquake and 1944 Tonankai earthquake, respectively. Orange-shaded area indicates ancient accretionary prism. (b) Schematic sections of the accretionary prism in the study area. Fully coupled and partially coupled plate interfaces are shown in red and orange, respectively. Credit: Kyushu University

Highly destructive earthquakes caused by subduction occur because of excessive friction that develops during the sliding process, resulting in a build-up of stress. A sudden release of this stress, a condition called rupturing, leads to the violent shaking felt during an earthquake.

A recent study led by the International Institute for Carbon-Neutral Energy Research (I2CNER) at Kyushu University in Japan, and published in Earth and Planetary Science Letters, now sheds new light on this stress build-up in tectonic plates. The focus was on the Nankai Trough, one of three major subduction zones offshore of Japan.

"Our understanding of the dynamic behavior of plate boundary faults has advanced," the study's lead author Takeshi Tsuji says. "Yet the factors that control the build-up of friction and stress along plate interfaces and in co-seismic zones are less established."

The researchers used advanced 2D and 3D seismic profiles to reveal the detailed structure of the Nankai Trough, particularly of an ancient accretionary prism - a large mass of rock and sediment accumulated in the trough.



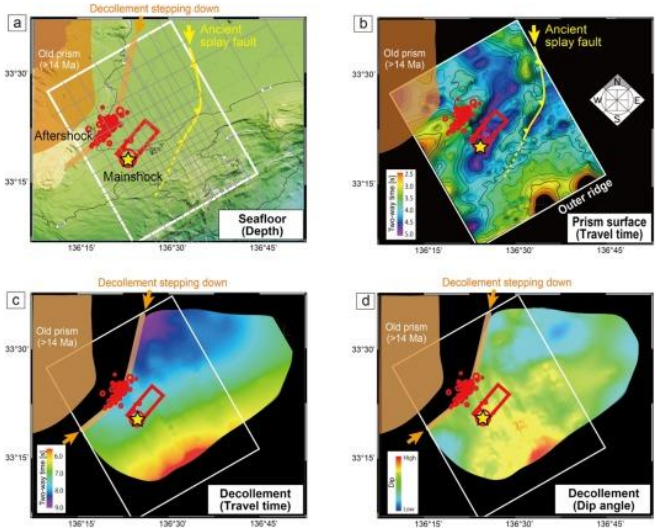
Location map showing tectonic, bathymetric, and geologic features of the study area. Hypocenters of the 2016 Off-Mie earthquake (yellow star) and the 1944 Tonankai earthquake (blue star) are shown along with the coseismic slip distribution of the 1944 earthquake (red contours, 0.5 m intervals; Kikuchi et al., 2003). Blue lines are the locations of seismic survey lines; numbers on the lines indicate the figure numbers of the corresponding seismic profiles. Triangles indicate ocean bottom seismometer used for seismic interferometry analysis, and yellow circles indicate the hypocenters of the 2005 earthquake. Black rectangle indicates the area shown in the image below. Fine lines are other seismic survey lines referred in the study. Credit: Takeshi Tsuji et al. (Elsevier)

The added mass of this rock and sediment has impeded subduction, ultimately causing stress to build up over time. This stress build-up, and rupturing, was the root cause of the massive 1944 Tonankai earthquake and the smaller Off-Mie earthquake that struck almost the same area on April 1, 2016.

"Along with evidence of frictional obstruction to subduction," Tsuji says, "the fault structure appears to have also impacted earthquake location and behavior. We found that aftershocks of the 2016 quake only occurred in front of the accretionary prism, where stress accumulation is greatest."

The long-term implications of the study hinge on evidence that the pre-existing faults from the 1944 earthquake have strongly influenced the orientation and location of rupturing during the 2016 event, suggesting that large earthquakes in Japan are most likely to occur in this very same region of the Nankai Trough in the future.

(Steven Young / the watchers, October 26, 2017, https://watchers.news/2017/10/26/japanese-earthquake-zone-strongly-influenced-by-the-effects-of-friction/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)



Maps showing the relation between the 2016 Off-Mie earthquake rupture and geologic structures around the Kumano basin. (a) Seafloor bathymetry. The thin gray lines are the locations of seismic profile to extract the horizons shown in panels (b)–(d). (b) Topography of the top surface of the accretionary prism (time domain). (c) Geometry of the plate boundary décollement (time domain). (d) Dip of the plate boundary décollement. Orange area indicates the old accretionary prism or igneous dome. Orange line is where the plate boundary décollement soles onto the top of the oceanic crust. Yellow line is the trace of a splay fault beneath the Kumano forearc basin. Red rectangle and circles are the fault plane and aftershocks, respectively, of the 2016 Off-Mie earthquake (Wallace et al., 2016). Credit: Takeshi Tsuji et al. (Elsevier)

Study links Raton Basin earthquakes to oil and gas fluid injections, again

A rash of earthquakes in southern Colorado and northern New Mexico recorded between 2008 and 2010 was likely due to fluids pumped deep underground during oil and gas wastewater disposal, says a new University of Colorado Boulder study.

The study, which took place in the 5 700 km^2 (2 200 mi^2) Raton Basin along the central Colorado-northern New Mexico border, found more than 1 800 earthquakes up to magnitude 4.3 during that period, linking most to wastewater injection well activity. Such wells are used to pump water back in the ground after it has been extracted during the collection of methane gas from subterranean coal beds.

One key piece of the new study was the use of hydrogeological modeling of pore pressure in what is called the

"basement rock" of the Raton Basin - rock several miles deep that underlies the oldest stratified layers. Pore pressure is the fluid pressure within rock fractures and rock pores.

While two previous studies have linked earthquakes in the Raton Basin to wastewater injection wells, this is the first to show that elevated pore pressures deep underground are well above earthquake-triggering thresholds, said CU Boulder doctoral student Jenny Nakai, lead study author. The northern edges of the Raton Basin border Trinidad, Colorado, and Raton, New Mexico.

"We have shown for the first time a plausible causative mechanism for these earthquakes," said Nakai of the Department of Geological Sciences. "The spatial patterns of seismicity we observed are reflected in the distribution of wastewater injection and our modeled pore pressure change."

A paper on the study was published in the Journal of Geophysical Research: Solid Earth. Co-authors on the study include CU Boulder Professors Anne Sheehan and Shemin Ge of geological sciences, former CU Boulder doctoral student Matthew Weingarten, now a postdoctoral fellow at Stanford University, and Professor Susan Bilek of the New Mexico Institute of Mining and Technology in Socorro.

The Raton Basin earthquakes between 2008 and 2010 were measured by the seismometers from the EarthScope USArray Transportable Array, a program funded by the National Science Foundation (NSF) to measure earthquakes and map Earth's interior across the country. The team also used seismic data from the Colorado Rockies Experiment and Seismic Transects (CREST), also funded by NSF.

As part of the research, the team simulated in 3-D a 33.8 km (12 miles) long fault gleaned from seismicity data in the Vermejo Park region in the Raton Basin. The seismicity patterns also suggest a second, smaller fault in the Raton Basin that was active from 2008 - 2010.

Nakai said the research team did not look at the relationship between the Raton Basin earthquakes and hydraulic fracturing, or fracking.

The new study also showed the number of earthquakes in the Raton Basin correlates with the cumulative volume of wastewater injected in wells up to about 9 miles away from the individual earthquakes. There are 28 "Class II" wastewater disposal wells - wells that are used to dispose of waste fluids associated with oil and natural gas production - in the Raton Basin, and at least 200 million barrels of wastewater have been injected underground there by the oil and gas industry since 1994.

"Basement rock is typically more brittle and fractured than the rock layers above it," said Sheehan, also a fellow at CU's Cooperative Institute for Research in Environmental Sciences. "When pore pressure increases in basement rock, it can cause earthquakes."

There is still a lot to learn about the Raton Basin earthquakes, said the CU Boulder researchers. While the oil and gas industry has monitored seismic activity with seismometers in the Raton Basin for years and mapped some subsurface faults, such data are not made available to researchers or the public.

The earthquake patterns in the Raton Basin are similar to other U.S. regions that have shown "induced seismicity" likely caused by wastewater injection wells, said Nakai. Previous studies involving CU Boulder showed that injection wells likely caused earthquakes near Greeley, Colorado, in Oklahoma and in the mid-continent region of the United States in recent years.

Source: University of Colorado Boulder

(Steven Young / The Watchers, October 26, 2017, https://watchers.news/2017/10/26/study-links-raton-basin-earthquakes-to-oil-and-gas-fluid-injections-again/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

Σεισμοί και Κοινωνία

Οι πρόσφατοι σεισμοί της Λέσβου και της Κω, ανέδειξαν για μια ακόμη φορά τα δομικά προβλήματα των σύγχρονων ελληνικών πόλεων σε σχέση με την αντισεισμική πολιτική της χώρας και την ετοιμότητα της, αν και η ανταπόκριση των εντεταλμένων οργάνων της στους προσφάτους σεισμούς κρίνεται ικανοποιητική.

Οφείλουν, όμως, να προετοιμάζονται, όπως όλοι μας, και να βελτιώνουν συνεχώς την επιχειρησιακή τους ετοιμότητα, λαμβάνοντας διαρκώς υπόψη τη συνεχιζόμενη αστικοποίηση, τις τεχνολογικές εξελίξεις, τις επεκτάσεις των υποδομών και γενικά την αύξηση του βαθμού πολυπλοκότητας της κοινωνίας.

Οι σεισμοί όμως της Ιταλίας πριν ένα χρόνο, με την ιδιαιτερότητα τους ως φυσικό φαινόμενο, τους αδικαιολόγητα πολλούς νεκρούς (297) και τις καταρρεύσεις και οι ισχυρότατοι σεισμοί στο Μεξικό (7 και 19/9/2017) αναδεικνύουν μια άλλη πολύ σημαντική διάσταση του προβλήματος. Τις απρόβλεπτες ακραίες επιπτώσεις του φαινόμενου.

Σύμφωνα με το μοντέλο υπολογισμού αναμενόμενων σεισμών της Αμερικανικής Γεωλογικής Υπηρεσίας (USGS) στην περιοχή έξω από την ακτή του Μεξικού, το πιθανό μέγιστο αναμενόμενο μέγεθος υπολογιζόταν σε 7,2 και συνέβη σεισμός μεγέθους 8,1.

Οι υπολογισμοί προβλέπουν ότι οι οικονομικές απώλειες είναι πιθανόν να ανέλθουν σε περισσότερα από 1 δισ. δολάρια και οι ανθρώπινες απώλειες σε εκατοντάδες.

Η περίπτωση αυτή υπογραμμίζει τον απρόβλεπτο χαρακτήρα των σεισμών και ότι σε σεισμογενείς περιοχές με μεγάλους σεισμούς, όπως και η χώρα μας, οι κάτοικοι πρέπει να γνωρίζουν τους κινδύνους και ο σχεδιασμός αντισεισμικής προστασίας να είναι διαφορετικός από το συνηθισμένο.

Δυστυχώς, στις περισσότερες περιπτώσεις η χειρότερη εκδοχή (ακραίο σενάριο) είτε δεν γίνεται κατανοητή ή αγνοείται ή δεν λαμβάνεται σοβαρά υπόψη. Και όμως συμβαίνει !

Πολλές οι πτυχές που πρέπει να επανεξεταστούν και πρώτα η έρευνα, η οποία από ατομική ή μικρών ανταγωνιστικών ομάδων θα πρέπει να γίνει στοχευμένη, εφαρμοσμένη, από μεγαλύτερες ομάδες, δηλαδή ένωση Εργαστηρίων και Ινστιτούτων της χώρας, αλλά και της αλλοδαπής, με άμεσα πρακτικά αποτελέσματα.

Απαιτείται ριζική αλλαγή ερευνητικής νοοτροπίας, προκαθορισμένων στόχων, διεπιστημονική, ευρεία και καλά χρηματοδοτούμενη έρευνα, που θα λύνει αυστηρά καθορισμένα και συγκεκριμένα προβλήματα για τις ανάγκες της κοινωνίας.

Η ανάπτυξη της έρευνας, ποσοτικά και ποιοτικά με αύξηση του ανθρώπινου δυναμικού και εξοπλισμού, ο συντονισμός και η ισόρροπη ανάπτυξη ερευνητικών προσπαθειών σε ένα σύνολο επιστημονικών αντικειμένων, όπως η σεισμοτεκτονική, η αντισεισμική τεχνολογία, η χωροταξία, οι κοινωνικές επιστήμες, η σύνταξη μικροζωνικών μελετών και γεωλογικής καταλληλότητας, που θα λαμβάνονται υπόψη στον πολεοδομικό σχεδιασμό, ο καθορισμός όρων δόμησης, τα έργα υποδομής είναι απαραίτητοι παράμετροι για να σχεδιάζεται σιγά-σιγά και ορθολογικά το μέλλον.

Η σωστή ενημέρωση και εκπαίδευση της κοινωνίας, με έμφαση στην εκπαίδευση των νέων, αλλά και όσων επηρεάζουν δημόσια την κοινή γνώμη, κυρίως των δημοσιογράφων, αποτελούν επίσης άμεσες προτεραιότητες.

Δυστυχώς, η αντισεισμική πολιτική στη χώρα μας έχει περάσει σε δεύτερη μοίρα. Παρότι έχουμε εξαιρετικούς επιστήμονες, ο προγραμματισμός και η ευθύνη της πολιτείας δεν παύουν να είναι μεγάλης σημασίας.

Είναι πια κοινή η άποψη ότι απαιτούνται ριζικές παρεμβάσεις και αλλαγές στον αντισεισμικό σχεδιασμό της χώρας.

Ο σεισμός και οι επιπτώσεις του δεν μπορεί να αντιμετωπίζονται μόνο σαν ένα φυσικό φαινόμενο, αλλά σαν ένα πολυσύνθετο κοινωνικό, πολιτικό, οικονομικό φαινόμενο. Η αντισεισμική προστασία και θωράκιση της χώρας είναι ένα τεράστιο έργο υποδομής.

Σπύρος Παυλίδης
Καθηγητής Γεωλογίας Α.Π.Θ.
Πρόεδρος της Ελληνικής Γεωλογικής Εταιρίας.

("Εφημερίδα των Συντακτών, Σάββατο-Κυριακή 31.09 ÷ 01.10. 2017, http://www.efsyn.gr/arthro/kairos-gia-allages)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

(Θεόδωρος Λαΐνας / in.gr, 05 Οκτ. 2017, http://news.in.gr/science-technology/article/?aid=1500165823#ref=newsletter)

Ο μεγαλύτερος serial killer στη Γη ήταν... ρωσικά ηφαίστεια

Προκάλεσαν τη μαζικότερη εξαφάνιση ειδών

Οι επιστήμονες έχουν καταλήξει στο συμπέρασμα ότι στη διάρκεια της ύπαρξης της ζωής στη Γη έχουν υπάρξει πέντε μεγάλες μαζικές εξαφανίσεις ειδών. Η μεγαλύτερη συνέβη πριν από 252 εκατομμύρια χρόνια, στο τέλος της Περμίου περιόδου και εξαιτίας του εύρους της οι ειδικοί την έχουν ονομάσει το «Μεγάλο Θανατικό». Οι επιστήμονες εκτιμούν ότι τότε εξαφανίστηκε το 90% των θαλασσίων ειδών και το 70% των ζώων της στεριάς. Το γεγονός αυτό θεωρείται ότι άνοιξε τον δρόμο στην εμφάνιση και επικράτηση των δεινοσαύρων στον πλανήτη.

Έχουν πραγματοποιηθεί πολλές έρευνες για να εξακριβωθεί το τι προκάλεσε αυτή τη μαζική εξόντωση της ζωής. Οι πιο πρόσφατες υπεδείκνυαν ως αιτία την έντονη ηφαιστειακή δραστηριότητα.

Η τελευταία σχετική έρευνα πραγματοποιήθηκε από επιστήμονες του Πανεπιστημίου της Νέας Υόρκης και τα ευρήματα όχι μόνο επιβεβαιώνουν τη θεωρία των ηφαιστείων, αλλά εντοπίζουν και την περιοχή του πλανήτη που κυριολεκτικά... εξερράγη προκαλώντας την παγκόσμια καταστροφή.

Τι συνέβη

Η νέα μελέτη που δημοσιεύεται στην επιθεώρηση Scientific Reports αναφέρει ότι υπεύθυνα για το «Μεγάλο Θανατικό» είναι τα ηφαίστεια που βρίσκονταν εκείνη την εποχή στην Σιβηρία. Οι ερευνητές αναφέρουν ότι την επίμαχη περίοδο υπήρξε ένα μπαράζ κολοσσιαίων εκρήξεων που διήρκεσε δεκάδες ή και εκατοντάδες χιλιάδες έτη.

Οι εκρήξεις αυτές προκάλεσαν αλυσιδωτές γεωατμοσφαιρικές αντιδράσεις με αποτέλεσμα να σχηματιστεί ένα παχύ πέπλο από ηφαιστειακή σκόνη, διοξείδιο του άνθρακα, διοξείδιο του θείου, μεθάνιο και πτητικές οργανικές χημικές ουσίες που περιείχαν νικέλιο.

Το πέπλο αυτό σκέπασε για μεγάλο χρονικό διάστημα την Γη μετατρέποντας την σε ένα τόπο τοξικό και άκρως αφιλόξενο στη ζωή. Σύμφωνα με τους ερευνητές η ηφαιστειακή δραστηριότητα στην περιοχή της Σιβηρίας απελευθέρωσε περίπου ένα τρισεκατομμύριο λίτρα λάβας! Έτσι δημιουργήθηκαν και τα περίφημα «Σκαλιά της Σιβηρίας» μιας τεράστια περιοχή ηφαιστειογενών πετρωμάτων που απλώνεται σε έκταση 2 εκατ. τ.χλμ. στον βορρά της Ρωσίας.

Scientists determine source of world's largest mud eruption

On May 29, 2006, mud started erupting from several sites on the Indonesian island of Java. Boiling mud, water, rocks and gas poured from newly-created vents in the ground, burying entire towns and compelling many Indonesians to flee. By September 2006, the largest eruption site reached a peak, and enough mud gushed on the surface to fill 72 Olympic-sized swimming pools daily.

Indonesians frantically built levees to contain the mud and save the surrounding settlements and rice fields from being covered. The eruption, known as Lusi, is still ongoing and has become the most destructive ongoing mud eruption in history. The relentless sea of mud has buried some villages 40 meters (130 feet) deep and forced nearly 60 000 people from their homes.

On May 29, 2006, mud started erupting from several sites on the Indonesian island of Java and hasn't stopped since. The eruption became known as Lusi *and is the most destructive ongoing mud eruption in history. Credit: Adriano Mazzini/The Lusi Lab Project.*

The volcano still periodically spurts jets of rocks and gas into the air like a geyser. It is now oozing around 80 000 cubic meters (3 million cubic feet) of mud each day – enough to fill 32 Olympic-sized pools.

Now, more than 11 years after it first erupted, researchers may have figured out why the mudflows haven't stopped: deep underground, Lusi is connected to a nearby volcanic system.

In a new study, researchers applied a technique geophysicists use to map Earth's interior to image the area beneath Lusi. The images show the conduit supplying mud to Lusi is connected to the magma chambers of the nearby Arjuno-

Welirang volcanic complex through a system of faults 6 kilometers (4 miles) below the surface.

Volcanoes can be connected to each other deep underground and scientists suspected Lusi and the Arjuno-Welirang volcanic complex were somehow linked because previous research showed some of the gas Lusi expels is typically found in magma. But no one had yet shown that Lusi is physically connected to Arjuno-Welirang.

The researchers discovered that the scorching magma from the Arjuno-Welirang volcano has essentially been "baking" the organic-rich sediments underneath Lusi. This process builds pressure by generating gas that becomes trapped below the surface. In Lusi's case, the pressure grew until an earthquake triggered it to erupt.

Studying the connection between these two systems could help scientists to better understand how volcanic systems evolve, whether they erupt magma, mud or hydrothermal fluids.

https://www.youtube.com/embed/1PXS1OIAD4o

"We clearly show the evidence that the two systems are connected at depth," said Adriano Mazzini, a geoscientist at CEED – University of Oslo and lead author of the new study in the Journal of Geophysical Research: Solid Earth, a journal of the American Geophysical Union. "What our new study shows is that the whole system was already existing there – everything was charged and ready to be triggered."

Finding a connection

Java is part of a volcanic island arc, formed when one tectonic plate subducts below another. As the island rose upward out of the sea, volcanoes formed along its spine, with basins of shallow water between them. Lusi's mud comes from sediments laid down in those basins while the island was still partially submerged underwater.

Mazzini has been studying Lusi since soon after the eruption began. Two years ago, the study's authors installed a network of 31 seismometers around Lusi and the neighboring volcanic complex. Researchers typically use seismometers to measure ground shaking during earthquakes, but scientists can also use them to create three-dimensional images of the areas underneath volcanoes.

Using 10 months of data recorded by the seismometers, Mazzini and his colleagues imaged the area below Lusi and the surrounding volcanoes. The images showed a tunnel protruding from the northernmost of Arjuno-Welirang's magma chambers into the sedimentary basin where Lusi is located. This allows magma and hydrothermal fluids originating in the mantle to intrude into Lusi's sediments, which triggers massive reactions and creates gas that generates high pressure below Earth's surface. Any perturbation – like an earthquake – can then trigger this system to erupt.

"It's just a matter of reactivating or opening these faults and whatever overpressure you have gathered in the subsurface will inevitably want to escape and come to the surface, and you have a manifestation on the surface, and that is Lusi," Mazzini said.

Triggering an eruption

Mazzini and other researchers suspect a magnitude 6.3 earthquake that struck Java two days before the mud started flowing was what triggered the Lusi eruption, by reactivating the fault system that connects it to Arjuno-Welirang.

By allowing magma to flow into Lusi's sedimentary basin, the fault system could be an avenue for moving the entire volcanic system northward, said Stephen Miller, a professor of geodynamics at the University of Neuchâtel in Neuchâtel, Switzerland who was not connected to the study.

"It looks like this might be the initial stages of this march forward of this volcanic arc," Miller said. "Ultimately, it's bringing all this heat over toward Lusi, which is driving that continuous system."

Mazzini and other scientists are unsure how much longer Lusi will continue to erupt. While mud volcanoes are fairly common on Java, Lusi is a hybrid between a mud volcano and a hydrothermal vent, and its connection to the nearby volcano will keep sediments cooking for years to come.

"So what it means to me is that Lusi's not going to stop anytime soon," Miller said.

Reference:

"The plumbing system feeding the Lusi eruption revealed by ambient noise tomography" - Mohammad Javad Fallahi et al. - Journal of Geophysical Research (AGU) - 2017 - DOI: 10.1002/2017JB014592

(The Watchers, October 17, 2017, https://watchers.news/2017/10/17/scientists-determine-source-of-worlds-largest-mud-eruption/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

The missing mass — what is causing a geoid low in the Indian Ocean?

The Earth's interior is still a mystery to us. While we have sent missions to probe the outer reaches of our solar system, the deepest boreholes on Earth go down to only a few kilometers. The only way to learn what's going on deep inside our planet, in the core and the mantle, is by indirect methods.

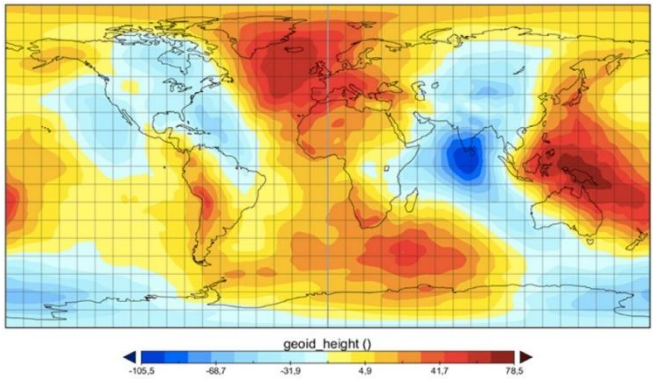
Many of us might have seen those beautiful pictures of our round, blue planet taken from space, but did you know that our planet actually looks like a bumpy potato? It has its own share of deformations, non-uniform gravity because of the unequal distribution of mass and occasionally, mountains and valleys created by the movements of tectonic plates. Considering that around three-fourths of our planet's surface is made up of oceans, these deformities affect the shape of the oceans too. If we removed the tides and currents from the oceans on the planet, they would settle onto a smoothly undulating shape called a geoid, rising wherever there is high gravity, and sinking where gravity is low, creating what are known as "geoid anomalies". These highs and lows are generated by uneven mass distribution within the deep Earth.

One such point of low gravity is found just south of the Indian peninsula, called the Indian Ocean Geoid Low (IOGL). The geoid low spans a vast extent south of the Indian subcontinent and is dominated by a significant low of minus 106 meters, or roughly 348 feet, south of Sri Lanka.

"The existence of the Indian Ocean geoid low is one of the most outstanding problems in Earth Sciences," said Attreyee Ghosh, an assistant professor at the Centre for Earth Sciences, Indian Institute of Science, in Bangalore, India. "It is the lowest geoid/gravity anomaly on Earth and so far no consensus existed regarding its source. It is re-

markable as it means that there is some mass deficit in the deep mantle that's causing the low."

"A low gravitational potential would mean that the ocean surface itself would go down," she said. "So, for a 100 meter (328 feet) geoid low the ocean surface would dip down by 100 meters at that region."



A map modeling the geoid surface. The map shows how water elevation and distribution would change by removing the effects of tides and currents.

In a recent study accepted for publication in Geophysical Research Letters, a journal of the American Geophysical Union, Ghosh and her colleagues, in collaboration with researchers from the GFZ German Research Centre for Geosciences, Germany, explored the reasons behind the mass deficit that is causing the geoid low. Several studies in the past have tried to explain this, most of them attributing it to a remnant of an earlier plate that dived into the Earth's mantle beneath another plate millions of years ago. However, there has been no convincing explanation of the source — until now.

In their study, the researchers used numerical models of mantle convection — a type of movement caused within a fluid where hotter and lighter material rise to the top and cooler and denser material sinks under the influence of gravity. To 'look' deep inside the Earth, they used seismic tomography models that use seismic waves to obtain a 3-dimensional picture of the Earth's interior.

The study showed that lighter material (low-density anomalies) in the upper to mid-mantle below the IOGL seem to be responsible for the existence of the gravity low in this region. But what causes these low-density anomalies?

Mantle plumes, upwellings of abnormally hot rock within the Earth's mantle, are generally thought to be the reason behind such anomalies. But in this case, no known mantle plume exists in this part of the world. To explain this, the researchers had to investigate the neighboring regions of the Indian Ocean geoid low. Interestingly, they found that there was hot material arising from the African large low-shear-velocity province (LLSVP) or the African superplume, that was getting deflected eastward and terminating at the base of the low-density region beneath the Indian Ocean low. The deflection is possibly due to the fast motion of the Indian plate.

"Most of the existing theories have tried to explain this negative anomaly with the help of cold, dense oceanic plates that sank into the mantle in the past", says Prof Ghosh. "Our study explains this low with hotter, lighter material stretching from a depth of 300 km, or 186 miles, up to ~900 km, or 559 miles, in the northern Indian Ocean, most likely stemming from the African superplume."

This study is definitely a breakthrough in convincingly explaining the occurrence of the Indian Ocean Geoid Low. As part of future work, Prof. Ghosh and her colleagues would like to investigate the evolution of the geoid low from the past to the present using time-dependent mantle convection models.

Reference:

"The Importance of Upper Mantle Heterogeneity in Generating the Indian Ocean Geoid Low" - Attreyee Ghosh - Geophysical Research Letters (AGU) - 2017 - DOI: 10.1002/2017GL075392

Written by Spoorthy Raman (Research Matters)

(Steven Young / TheWatchers, October 17, 2017, https://watchers.news/2017/10/17/the-missing-mass-what-is-causing-a-geoid-low-in-the-indian-ocean/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

An episode of MasterChef inspired a researcher from the University Nottingham to develop a new technology for repairing cracks in road surfaces

After watching a contestant on the Spanish version of the show use a technique known as spherification (the controlled jellification of a liquid to form spheres), Dr Alvaro Garcia, from the Nottingham Transportation Engineering Centre (NTEC), began exploring how the addition of microcapsules of oil to asphalt could be used to create self-repairing road surfaces.

The idea is that as cracks appear in the road the capsules break open, releasing the oil within and softening the asphalt around it. This helps the asphalt 'stick' back together, effectively filling in cracks and preventing small defects from deteriorating further.

Working with funding from Highways England, Garcia's team has created and carried laboratory tests on microcapsules filled with sunflower oil. Commenting on the research Garcia said, 'Our preliminary results showed that the capsules can resist the mixing and compaction processes without significantly reducing the physical and mechanical properties of asphalt and they also increased its durability. More importantly, we found that the cracked asphalt samples were restored to their full strength, two days after the sunflower oil was released.'

Sunflower oil can reverse the effects of ageing in bitumen used in asphalt by reducing the viscosity of the binder. The microcapsules created by Dr Garcia and his team, help to reduce the amount of other healing agents used because they can be activated in precise areas when required, thus avoiding the need to be mixed up in bulk.

Garcia estimates that the material – which he has named Capheal – could increase a road's lifespan by at least one-third from 12 to 16 years and costs about the same as other additives that are commonly used in asphalt paving.

He added that is has potential advantages over other road healing technologies, which often rely on additional equipment. "I previously worked on developing self-healing roads in the Netherlands and Switzerland that featured metal fibres," said Garcia. "An induction heater would pass over the surface to melt the bitumen and fill in cracks in the roads, but the problem with that is you need a large machine, which is expensive and requires a road to be closed to traffic."

https://www.youtube.com/embed/r1MoPxZsUoY?feature=oembed

NTEC's team is near the end of the initial stage of the project with the successful completion of laboratory tests and pilot trials. After this, Highways England will test bed Capheal on carefully selected sections of a road during planned overnight maintenance work. This will be followed by a monitoring period of about 12 to 24 months to determine Capheal's level of durability and endurance.

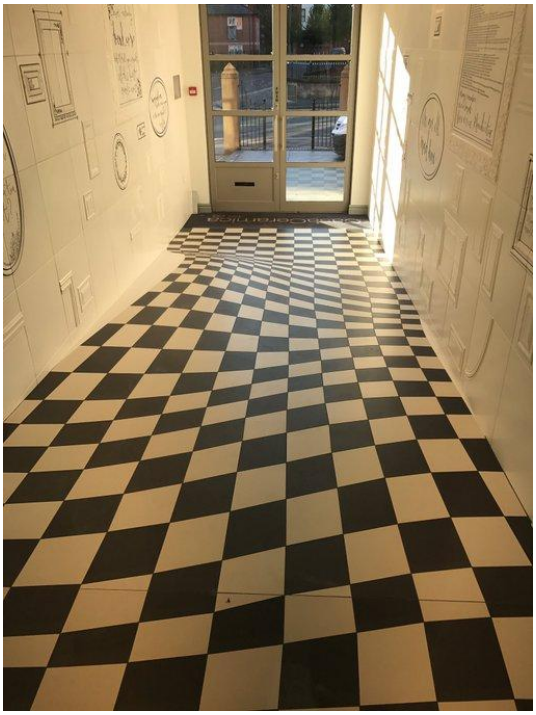
(theENGINEER, 18th October 2017, https://www.theengineer.co.uk/masterchef-self-healing-road/?cmpid=tenews_4138697&adg=767376ef-22e9-42c2-b1d3-e4762727e8f9)

This Corridor's Insane Tiling Is Baffling People

This optical illusion hallway might make you feel nauseous. The clever design looks like the floor is wonky but it's actually perfectly straight!

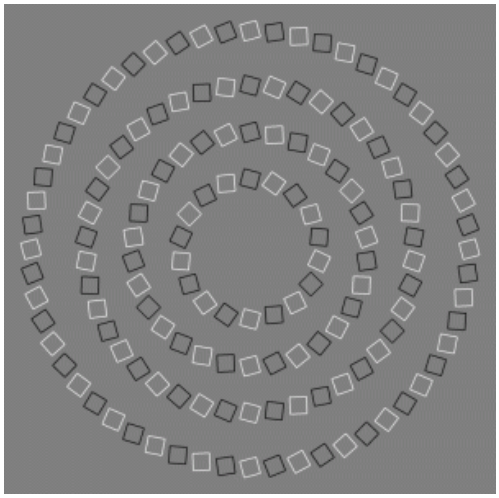
This tile company wants to keep you on your toes. Casa Ceramic shared pictures of an entryway they installed that will make your stomach flip, the black and white tiles make it look like the floor is severely warped. But the very clever tiling is done on a perfectly straight floor - yup - it's all optical illusion.

The floor was installed by the British tile company to demonstrate the talents of their designers and contractors. Sales administrator for the company, Harry Molyneaux admitted that the effect is much more dramatic when viewed via a photograph. The floor was installed about a year ago to demonstrate what can be done with tile, and it's apparently not as intense up close. He added, "the floor is completely flat and safe to walk over." The company has also released videos of people walking across the floor, which go to show just how easily our brains are tricked by visuals. Users on Reddit had a good suggestion for the wacky tiling job. It could be very effective in stopping children running in school corridors.



Optical Illusions have been bending our minds since the 5th century B.C.

Optical illusions have been entertaining us since the 5th century B.C. In this time, there was a much-heated debate about what caused optical illusions and if our human senses were to blame for the trickery or if it was something to do with the environment. It is believed that the Greek philosopher Aristotle, eventually waded into the debate suggesting it was a combination of environment and the human senses. The investigation was later taken up by Plato who was more adamant that all the human senses had the ability to be 'tricked' to believe something that was not true. Today we can classify optical illusions as a visual that is perceived differently from its reality. Information on the visual is gathered by the eye and processed by the brain that does not match with the recognized physical parameters of the stimulus.



Illusions are used in art, architecture and even therapy

There are generally agreed to be three main types of optical illusions. These are literal optical illusions, psychological illusions that are created from excessive stimulation from one source such as color, tilt or movement and the last is cognitive illusions that are created from unconscious inferences.

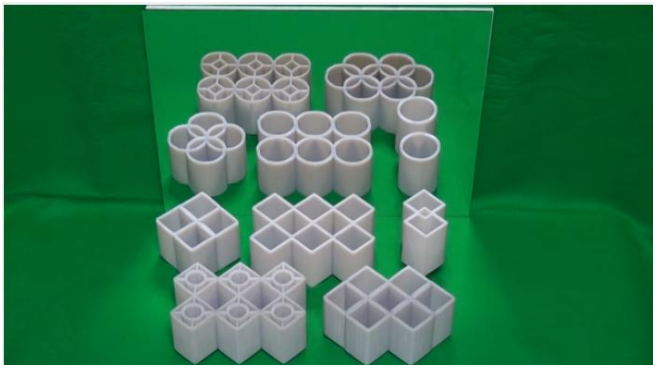
Optical illusions are consistently used in art and architecture to confuse and intrigue. In ancient Greece, the effect was used on the roofs of temples to make them look bowed or curved. In more contemporary times, illustrators like M.C Escher used optical illusions to show two different motifs in the same drawing. The 'perception' of optical illusions is often cited by Gestalt therapists as a way to gain insight into an individual's understanding of incoming sensations. Gestalt therapists have been known to be intrigued by patients' perceptions when looking at optical illusion where two images can be switched back and forth in a person's mind such as the rabbit-duck illusion.

(Jessica Miley / INTERESTING ENGINEERING, October, 11th 2017, https://interestingengineering.com/this-corridors-insane-tiling-is-baffling-people?_source=newsletter&_campaign=a9DP2nRWJjDM5&_uid=9wdL9JEwej&_h=9480fc0933eb231a0575c535417bef075ed6e805&utm_source=newsletter&utm_medium=mailing&utm_campaign=Newsletter-12-10-2017)

Top 10 of the Most Insane Optical Illusions

Optical illusions can be some of the most difficult to understand and impossible to comprehend things in the world. Even if you know the trick behind the illusion, it is near impossible to keep your eyes in line with reality. Since our brain takes jumps and makes assumptions in processing visual cues, it can often lead to our eyes being tricked into seeing something that isn't there. We have put together the top 10 most viral and insane optical illusions on the internet. Can you figure them out?

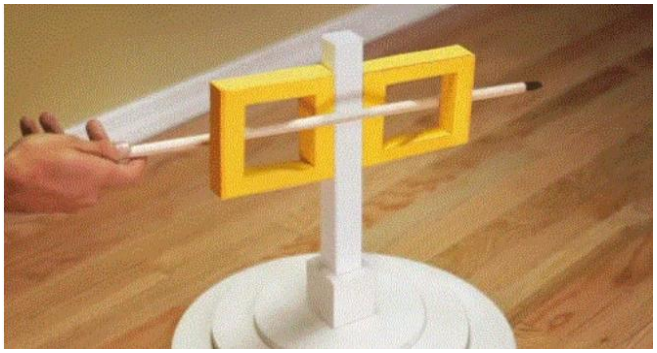
Cylinders or Diamonds?



https://www.youtube.com/watch?v=oWfFco7K9v8

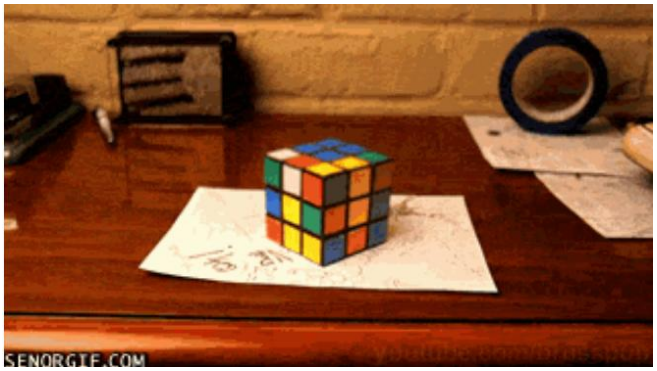
This illusion is currently making the rounds across the internet, and even when you know how it works, it is mind boggling to look at. As a hint, the trick lies in the perspective of the camera, and the shapes being seen don't look like you may think.

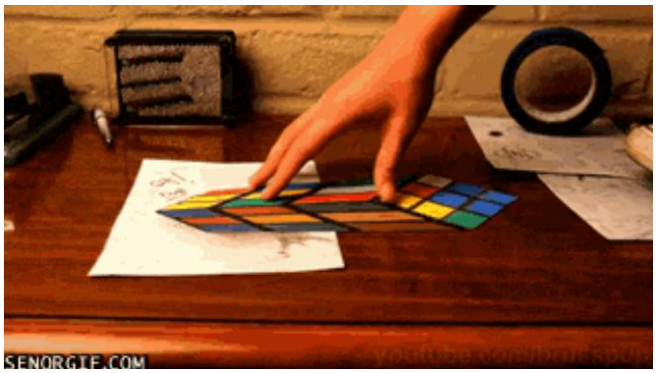
Forced Perspective



Forced perspective is one of the best tricks that illusion makers can use to trick our visual receptors. It can make certain shapes appear completely different from specific angles.

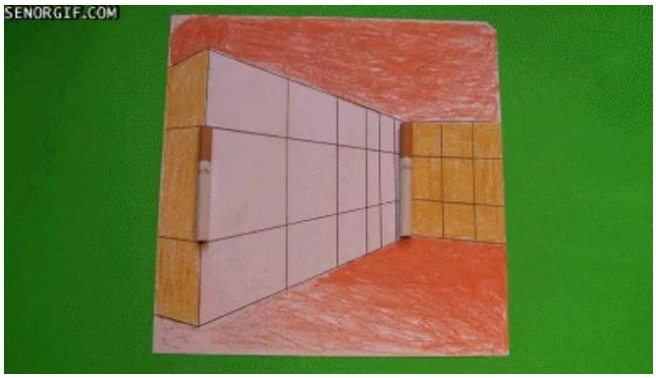
2-Dimensional Cube





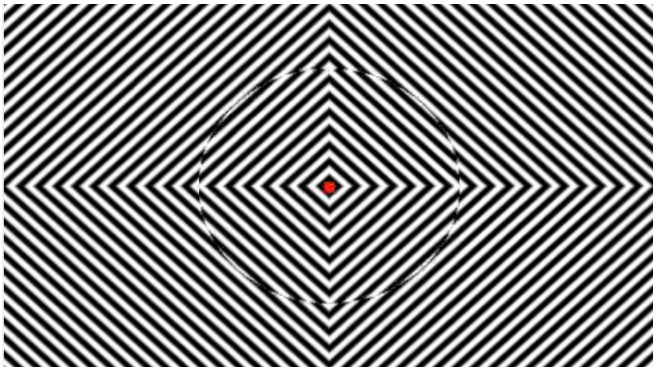
This is another stunning example of perspective, but this time, the illusion uses a 2-dimensional image to portray a 3-dimensional shape. When our brain sees what appears to be shadows and lighting corresponding to a 3D object, it processes it as one.

Shrinking Cigarette



One of the reasons this illusion is so encapsulating is because it is easy to do and understand, but you just can't keep your brain from thinking the cigarette is shrinking. You can even make this illusion at home with a sheet of paper and some pens, and it is still just as amazing.

Tripping Acid



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

When our eyes perceive repetitive motions, they lock in the patterns in order to decrease the amount of information being processed each second. This is a helpful biological practice as it allows us to pinpoint objects out of the ordinary in daily life, but this video exploits it. Those of you with certain medical conditions may not want to watch this video, because you will be seeing waves after staring at the screen.

Flat 3D Lamp

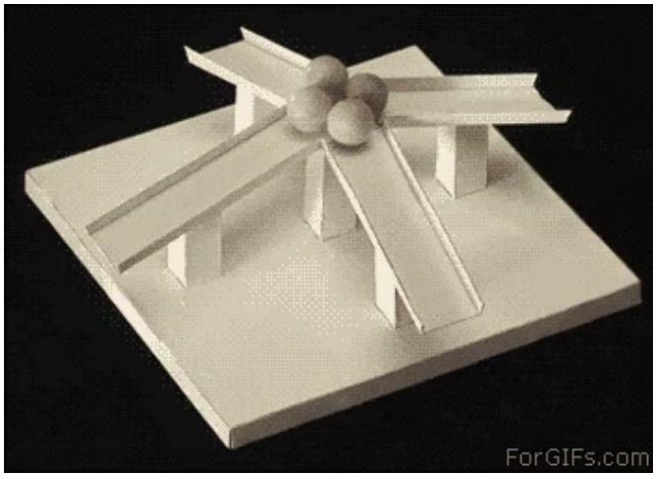
Not only are optical illusions fun to look at on a screen, they can also be implemented into products to fool your eyes in

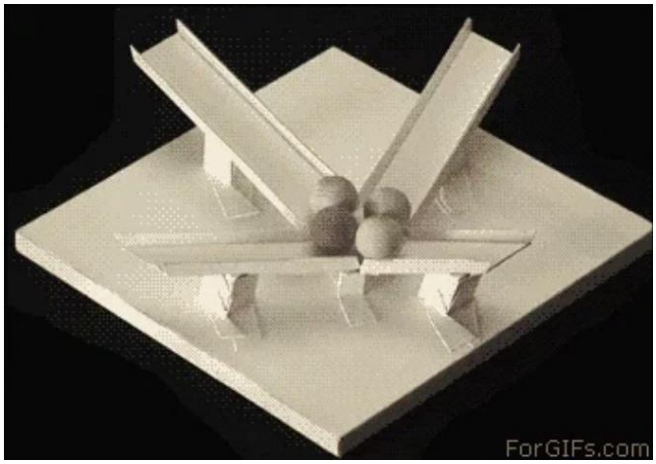
everyday life. This lamp takes your brain's assumption that it is 3D and creates a grid that makes it appear as just that.

Perfectly Aligned Shadows

If you were waiting for the car to crash into the pillars, you weren't alone. This is another great example of a perspective illusion that uses our knowledge of shadows to fool our eyes.

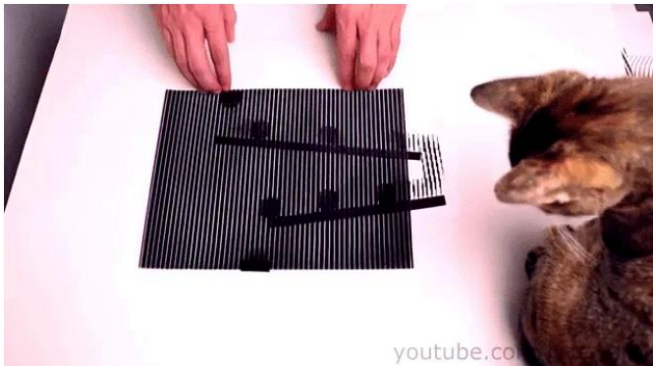
Crest or Valley?





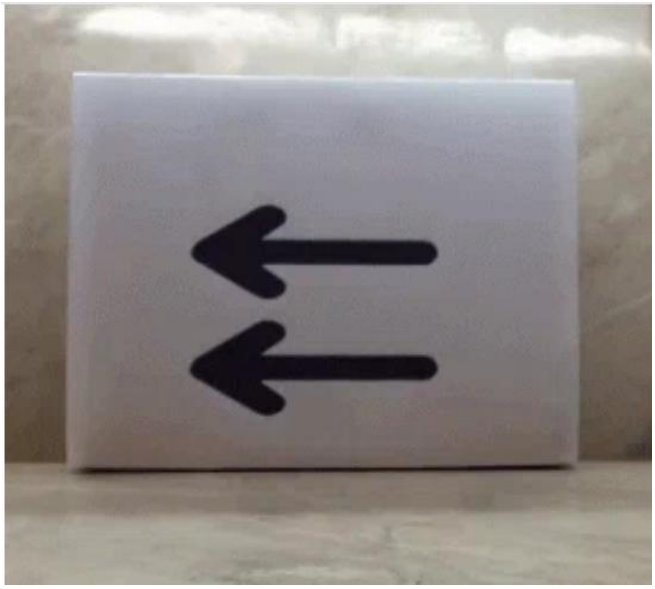
Making something look like a peak but actually be a valley is nothing short of amazing. This will fool you every time.

Illusion of Motion



When images of motion are split up in frames, viewing those frames in quick succession produces the illusion of motion. This example is a primitive demonstration of how early movies would create motion, and it's quite effective at tricking our eyes.

Refracted Arrows



Water makes for a great lens, and its refractive properties have been at the heart of many practical optical illusions. This is another trick that is fairly simple to try at home, and maybe learn a thing or two about refraction and lenses.

(Trevor English / Interesting Engineering, July, 05th 2016, https://interestingengineering.com/top-10-insane-optical-illusions)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.issmge.org/filemanager/article/473/ISSMGE_BULLETIN_2017_OCT-FINAL.pdf

Κυκλοφόρησε το Τεύχος 5 του Τόμου 11 του ISSMGE Bulletin (Οκτωβρίου 2017). Στο τεύχος αυτό παρατίθεται εκτενέστατο απόσπασμα (22 σελίδων) του επετειακού Τεύχους 100 του περιοδικού της ΕΕΕΕΓΜ. Τα περιεχόμενα του τεύχους έχουν ως ακολούθως:

- Message from the New President of ISSMGE
- Message from the New Editor-in-Chief of ISSMGE Bulletin
- Research highlights: University of Alberta, Canada
- **Extract of the 100th Issue of HSSMGE Electronic Bulletin**
- TC corner: TC106 – Doctoral School of Unsaturated Soil Mechanics, EPFL, Lausanne, Switzerland
- ISSMGE Foundation reports
- Obituary – Professor George Goble
- Event Diary
- Corporate Associates
- Foundation Donors

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Κυκλοφόρησε το Τεύχος #149 του **Newsletter** του **Geoengineer.org** (Οκτωβρίου 2017) με πολλές χρήσιμες πληροφορίες για όλα τα θέματα της γεωμηχανικής. Υπενθυμίζεται ότι το Newsletter εκδίδεται από τον συνάδελφο και μέλος της ΕΕΕΕΓΜ Δημήτρη Ζέκκο (secretariat@geoengineer.org).

Ενδεικτικά αναφέρονται:

- Mexico gets hit again by deadly M7.1 earthquake (video)
- Under construction dam bursts in Laos (video)
- Introducing the Transparent Soil Wiki
- Failing Dam forces mass evacuation in Puerto Rico (video)
- The Benefits of Dynamic Pile Testing

http://campaign.r20.constantcontact.com/render?m=1101304736672&ca=e2584e63-a70f-4569-9d49-a2ef08498442

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www.icevirtuallibrary.com/toc/jgein/24/5

Κυκλοφόρησε το Τεύχος 5 του Τόμου 24 του περιοδικού GEOSYNTHETICS INTERNATIONAL με τα παρακάτω περιεχόμενα:

Stability analysis of geocell-reinforced retaining walls, F. Song, H. Liu, H. Chai, J. Chen, pp. 442–450

Global challenges, geosynthetic solutions and counting carbon, N. Dixon, G. Fowmes, M. Frost, pp. 451–464

Undrained stability analysis of embankments supported on geosynthetic encased granular columns, S. R. Mohapatra, K. Rajagopal, pp. 465–479

Behavior of carbon fiber-reinforced recycled concrete aggregate, M. Li, H. He, K. Senetakis, pp. 480–490

Hydraulic response of fibre-reinforced sand subject to seepage, K.-H. Yang, W. M. Adilehou, S.-T. Jian, S.-B. Wei, pp. 491–507

Effect of brine on long-term performance of four HDPE geomembranes, R. K. Rowe, M. Shoaib, pp. 508–523

Probabilistic assessment of reinforced soil wall performance using response surface method, Y. Yu, R. J. Bathurst, pp. 524–542

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www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/45/issue/5

Κυκλοφόρησε το Τεύχος 5 του Τόμου 45 του περιοδικού

Geotextiles and Geomembranes με τα παρακάτω περιεχόμενα:

A numerical analysis of a fully penetrated encased granular column, Yung-Shan Hong, Cho-Sen Wu, Chien-Ming Kou, Cheng-Hsin Chang, Pages 391-405

Heat mitigation in geosynthetic composite liners exposed to elevated temperatures, Abdelmalek Bouazza, Mohammad Asgar Ali, R. Kerry Rowe, Will P. Gates, Abbas El-Zein, Pages 406-417

Fluid filling of a membrane tube with self-weight, C.Y. Wang, Pages 418-421

Shear strength of a fibre-reinforced clay at large shear displacement when subjected to different stress histories, Mehdi Mirzababaei, Arul Arulrajah, Suksun Horpibulsuk, Mark Aldava, Pages 422-429

Centrifuge model study on geogrid reinforced soil walls with marginal backfills with and without chimney sand drain, B.V.S. Viswanadham, Hamid Reza Razeghi, Jaber Mamaghanian, C.H.S.G. Manikumar, Pages 430-446

The effect of geotextile reinforcement and prefabricated vertical drains on the stability and settlement of embankments, E.M. Da Silva, J.L. Justo, P. Durand, E. Justo, M. Vázquez-Boza, Pages 447-461

Measuring hydraulic properties of geotextiles after installation damage, C. Cheah, C. Gallage, L. Dawes, P. Kendall, Pages 462-470

Effect of dynamic soil properties and frequency content of harmonic excitation on the internal stability of reinforced soil retaining structure, Anindya Pain, Deepankar Choudhury, S.K. Bhattacharyya, Pages 471-486

Analytical solutions to the axisymmetric consolidation of a multi-layer soil system under surcharge combined with vacuum preloading, Wan-Huan Zhou, Thomas Man-Hoi Lok, Lin-Shuang Zhao, Guo-xiong Mei, Xiao-Bo Li, Pages 487-498

Influence of relative density of soil on performance of fiber-reinforced soil foundations, Vaibhav Sharma, Arvind Kumar, Pages 499-507

Analytical study for double-layer geosynthetic reinforced load transfer platform on column improved soft soil, Balaka Ghosh, Behzad Fatahi, Hadi Khabbaz, Jian-Hua Yin, Pages 508-536

Creep analysis of an earth embankment on soft soil deposit with and without PVD improvement, Mohammad Rezania, Meghdad Bagheri, Mohaddeseh Mousavi Nezhad, Nallathamby Sivasithamparam, Pages 537-547

A major failure involving an exposed geotextile to contain dredged spoil, Warren Hornsey, Bill Service, Pages 548-555

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2015 – 2018)

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