Aerial view of a mountain pass in Colorado

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& ΓΕΩΤΕΧΝΙΚΗΣ
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Αρ. 113 – ΑΠΡΙΛΙΟΣ 2018

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The Callanish Stones rise from the ground in the Outer Hebrides of Scotland. 2900 to 2600 B.C.

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Σειρά από δημοσιεύσεις και σύντομα άρθρα παλαιοτέρων ετών που αναφέρονται στην Σεισμική Μηχανική.

The damage from famous California temblors

Damage from the 1971 Sylmar earthquake

San Francisco - April 1906, Magnitude 7.8 (est.)

Quake and resulting fire estimated to have killed more than 3,000 people, injured thousands more and destroyed about 28,000 buildings, leaving some 250,000 people homeless and resulting in $400 million in damage, in 1906 dollars. Cisterns were later strengthened to ensure that water would be available to fight fires after future temblors.

Long Beach - March 1933, Magnitude 6.4

Quake south of Los Angeles caused 120 deaths and $50 million in property damage. Most of the buildings destroyed had unreinforced masonry, including many schools. As a result, earthquake-resistant design and construction were mandated for public schools.

Sylmar - February 1971, Magnitude 6.6

Quake, above, caused more than $500 million in property damage and 65 deaths. Most of the deaths occurred when a Veterans Administration hospital collapsed. In response, building codes were strengthened, and buildings including apartments and hospitals were prohibited from being built across active faults.

Loma Prieta - October 1989, Magnitude 7.0

Quake killed between 62 and 67 people, injured around 4,000—including 400 severe injuries—and damaged or destroyed 12,000 homes and 2,600 businesses, resulting in around $6 billion in damage, in 1989 dollars. Following the quake, California's building code was updated, the state's office of emergency services was built out and neighborhood emergency response groups were created. San Francisco adopted a system for indicating the safety of buildings following an earthquake and established a program to conduct seismic assessments of buildings prior to an earthquake.

Damage from the 1994 earthquake in Northridge, California

Northridge - January 1994, Magnitude 6.7

Quake 20 miles northwest of Los Angeles, left, caused 57 deaths, more than 5,000 injuries and $20 billion in property damage. Sections of major freeways, apartment buildings and office buildings collapsed. Steel-frame "earthquake-proof" buildings suffered severe damage, resulting in new design and construction standards for high-rise buildings.

Sources: Southern California Earthquake Data Center; University of California, Berkeley; Federal Emergency Management Agency; U.S. Geological Survey; San Francisco Department of Building Inspection

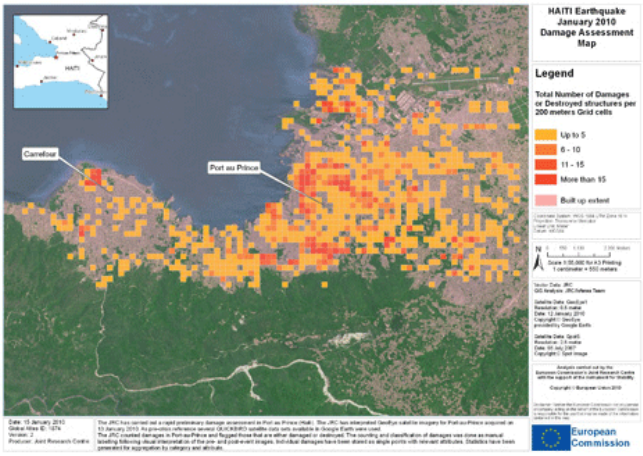
After shock

Engineering is vital to help poorer countries such as Haiti prepare for quakes, resulting in more durable buildings and, as a result, significantly fewer fatalities.

Poor construction methods caused widespread building collapse in Haitian capital Port-au-Prince, leading to catastrophic loss of life

The aftermath of last month's Haiti earthquake appalled the world. The 7-magnitude tremor on 12 January, and its subsequent aftershocks, caused widespread damage in the capital, Port-au-Prince, and its surroundings. As The Engineer went to press, some 20,000 commercial buildings and

225,000 residential buildings were believed to have been destroyed, while the death toll exceeded 200,000.



This EC map shows the extent of damage to buildings in Port-au-Prince

What role can engineering play in earthquakes? It is quite obvious that it can help. Earthquakes of similar magnitudes in richer countries, where there are resources that can be devoted to seismic monitoring and earthquake-resistant buildings, generally see much lower death tolls, typically in the hundreds or lower. Engineering in poorer countries is a quite different matter, however.

RedR, an organisation that sends engineers into disaster zones to assist with humanitarian efforts and reconstruction, has a great deal of first-hand experience. Rumana Kabir, a RedR specialist in post-earthquake reconstruction, said that much of the problem is due to a lack of building codes or, where they do exist, a lack of enforcement. Read our 2008 interview with RedR chairman Robert Hodgson here.

Kabir was involved with reconstruction following the 2005 earthquake in Kashmir, which affected the Pakistani part of the region. 'There was a previous major earthquake there, in 1943, when it was still under British control, after which the administration did establish a building code,' she said. 'But we only discovered it after the earthquake. When we talked to engineers, we found that it had initially been enforced, but slowly the government officers just let the people build any way they wanted. There were a lot of problems with corruption and the regulatory bodies weren't actively taking part in establishing and enforcing the codes.'

This state of affairs is sadly typical of poorer countries, but in the case of Haiti there was another factor at play: although the country is on a known tectonic fault line, there hadn't been an earthquake there for 250 years. The Enriquillo-Plantain Garden Fault, between the North American and Caribbean plates, had been locked motionless for this period, during which stress steadily built up in the fault. 'Memory fades,' said Ian Main, professor of seismology and earth physics at Edinburgh University. 'There are other priorities for spending money and, in poor countries, engineering for earthquakes tends to be neglected. Low preparedness is typical.'

Traditional building techniques can be both a help and a hindrance, said Kabir. In many earthquake-prone regions of the world, such as South Asia and Latin America, the predominant building material is adobe, made from mud and straw. 'You don't get any building codes for that,' she added. 'They tend to only apply to urban housing, made from bricks and mortar and concrete; there are no guidelines for self-built houses in rural areas. The main cause of collapse there was the heavy roof falling off. People kept maintaining their houses with layer after layer of mud plastering and the roofs got heavier and heavier, but mud construction is brittle and earthquakes just make them collapse, often crushing the people inside.'

In some regions, traditional techniques are inherently earthquake resistant but, even then, some well-meaning legislation can have unforeseen consequences. 'In Indonesia, after the tsunami, everyone knew that traditional timber houses had many good features that made them more earthquake resistant, but there was a ban on using local timber to protect the Indonesian rainforest, so they couldn't rebuild in the traditional style,' said Kabir.

She believes that looking at best practices around the world and trying to introduce methods related to traditional techniques in a particular region might help to reduce fatalities. 'There are houses in Switzerland and Turkey, for example, that have mud construction but also use timber; they're based on a wattle-and-daub construction with woven walls, very lightweight construction, which is then plastered with mud,' said Kabir. 'I was with the organisation UN Habitat at the time and we spent nine months lobbying the Pakistani government and local engineers to show them how this could make traditional houses stronger. We had to provide engineering evidence and calculations and show examples from these other countries to convince them that this helped with earthquake resistance. But it took two years to convince them completely.'

The issue of preparedness is one that concerns Main, who was the UK member of an Italian presidential commission on earthquake forecasting for civil protection in the wake of the L'Aquila earthquake in April 2009. 'We were looking at whether you can use seismic information, such as the fact that there had been a swarm of small tremors before the L'Aquila quake, to determine whether you can give a warning of a major event,' he said. 'But the question is, what do you do with the information? Do you tell the population there's a one per cent chance of a big earthquake that year? What would they do? And what does a one per cent chance of an earthquake actually mean?'

The problem is that earthquakes are statistically unlikely in virtually every part of the world — it's more likely that there will not be an earthquake on any given day than there will be, even in seismically active areas. 'It's low probability but high vulnerability; an earthquake isn't likely, but if it does happen it's likely to be catastrophic,' Main explained. 'But that sort of situation is very hard for governments, even in more affluent areas. Politicians want clear-cut answers when it comes to spending money, and earthquake engineering isn't in the public consciousness often enough to persuade the government to spend money on that, rather than on a hospital.'

Even so, earthquake research is looking at ways that buildings can be made safer, even in poorer areas. Gopal Madubhishi of the Schofield Centre at Cambridge University operates a research facility that uses a 10m-diameter centrifuge to simulate the effects of earthquakes on scale models of buildings, particularly aimed at looking at how the foundations interact with shaking ground. 'The centrifuge can generate forces 100-150 times Earth's gravity and we scale structures down by the same factor,' he said. 'So when we spin our model, it behaves as though it had the weight of the full-size structure.'

As the model spins, a specially designed device known as a stored angular momentum (SAM) earthquake actuator shakes the model to simulate an earthquake. 'We've been doing this for 35 years and our actuators are getting better and better,' said Madubhishi. 'So are the monitors — we use the same type of camera that's used in cricket to show the vibration of the bat, which operates very fast, around 1,000 frames per second.'

Much of Madubhishi's work is to test the foundations of new buildings or to see how existing historic buildings can be made more earthquake resistant, but some work has been conducted into traditional buildings. 'One thing that we have found is that adobe can be made more ductile and, therefore, more earthquake resistant, if strips of plastic from carrier bags are incorporated into its structure,' he said. 'You can improve the performance of even simple structures using innovative engineering and it doesn't have to be expensive — this technique won't stop the building from being shaken to bits, but it will hold it together for long enough to get people out. However, we need a lot more of that kind of research to help these countries.'

Another possibility is to make the ground itself stronger. A major problem in earthquakes is soil liquefaction, where the tremors cause loose and gravelly soils to behave like a liquid. In L'Aquila, this made sewage pipes rise to the surface; in Port-au-Prince, it caused buildings to sink into the ground. However, Madubhishi's team has explored a technique called soil densification, where the ground is compacted (paradoxically, using high-frequency vibration) to stop liquefaction occurring. 'You can quantify the benefit, but there aren't any specific design guidelines on how much soil you have to densify,' he said. 'We showed that if you densify twice the area of the building, you get the maximum benefit; larger areas don't have a greater effect.'

For Haiti, this is a critical time for engineers to advise on how to rebuild, said Main. 'This is a window of opportunity,' he added. 'You have to go in now because, even in just a few years, memory will fade. But the engineers' role in a poor country is always a difficult one. There's a big educational role for engineers when they're taking on projects such as this; even if they aren't asked about future seismic risk, they can ask themselves. And Haiti is so vulnerable to other natural disasters, such as hurricanes and landslides.'

A consequence of the shocking pictures from Haiti is the response from public fundraising and non-government organisations (NGOs). 'These organisations have started funding seismic research themselves,' said Main. 'There are simple things you can do such as testing the natural resonances of the soil. You can do that with background noise and that will tell you about where to site the building and how to build on that site. You can make informed choices about materials.'

However, Kabir believes that there could still be pitfalls. 'You have a lot of NGOs on the ground and it's important to avoid them getting into competition with each other,' she said. 'If you want to build 10,000 houses and there's a shortage of skilled labour, then you can't enforce guidelines. You have to let go of certain standards, just to get the shelter up and available to displaced people. It's very important to have suitable but simple design and basic messages to put across to ensure that building goes quickly but in such a way that the buildings aren't vulnerable to future quakes.'

Main believes a hopeful message must come across. 'There is no doubt, none at all, that something can be done,' he said. 'In California in 1989, a magnitude-7 quake killed 63 people and that was because of an extraordinary event: a freeway collapsed. Death tolls such as Haiti don't happen in California. We can do something about this.'

Damage control: building tremor-resistant structures

For earthquake-prone countries in the developed world, there is no shortage of options for designing safer buildings. 'It's actually a fairly marginal cost to make a building earthquake resistant — there's no such thing as earthquake proof,' said Main.

Often used in California and Japan, where earthquakes of varying magnitudes are a frequent event, earthquake engineering makes buildings more resistant to ground shaking. There are two main ways to do this: either absorb the energy of the shaking within the building's structure or decouple the main building structure from the ground so that the building moves much less when the ground begins to shake.

The tuned mass damper in the Taipei 101 skyscraper is a 660tonne steel sphere, made from flat circular plates welded together

Neither of these concepts are new. The Incas built cities such as Machu Picchu using dry-stone walls out of blocks cut to fit together. During an earthquake, the blocks could move slightly against each other, dissipating the energy of the quake and preventing resonant vibrations developing.

The main tuned mass damper in Taipei 101 sits above the 87th floor

Decoupling the building from its foundation, which is known as base isolation, is possibly even older. Examples are known from more than 2,500 years ago in ancient Persia.

Energy absorption techniques now reach their most spectacular in skyscrapers, which sway with a characteristic frequency during earthquakes. Massive pendulums are installed at the top of the tower, mounted on springs so they move in such a way as to counter the frequency of the swaying.

Known as tuned mass damping, the technique is used in the Taipei 101 skyscraper in Taiwan, which, until last month, was the tallest building in the world. Taipei 101 has three tuned mass dampers; a 660-tonne, 5.5m-diameter steel sphere suspended between the 88th and 92nd floors; and two smaller dampers, each weighing 6 tonnes, at the top of the spire, more than 500m up.

Base isolation now generally involves connecting the building's foundations to the building itself via shock absorbers. 'This was used in the reconstruction after the L'Aquila earthquake,' said Main. 'The city built blocks of flats with a car park in the basement and the building itself is supported on isolation pillars.

'The pillars have shock absorbers on top with rubber components to absorb the vibration and a big concrete plate rests on top of the shock absorbers with the building itself on top of that,' he added. 'There's still some transfer of energy between the ground and the building, but it's significantly less than there would be otherwise.'

(Stuart Nathan / theengineer, 9 February 2010, https://www.theengineer.co.uk/issues/08-february-2010/after-shock)

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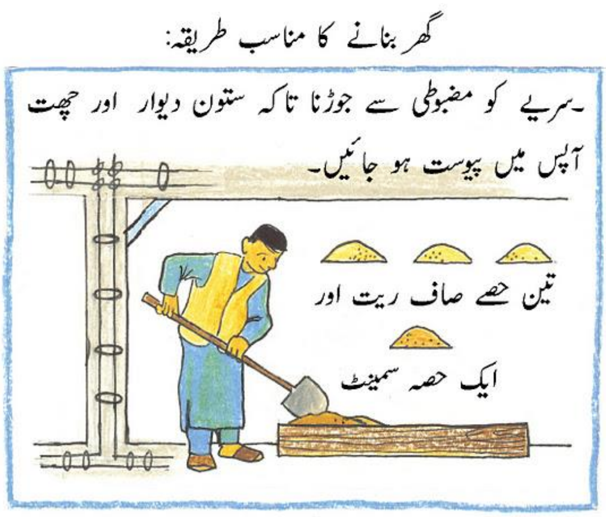
Building Safer, but Cheaply, in Quake Zones

That a modest earthquake in eastern Turkey on Monday took dozens of lives (probably many more than today's estimates) speaks to the importance of basic information on safer construction for masons, mayors and builders in seismic hot zones in rural regions as well as fast-growing cities.

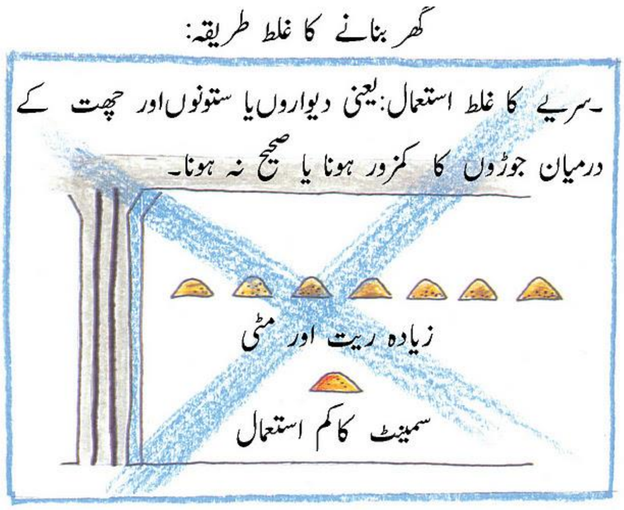
In one such effort, undertaken in Pakistan after the devastating Kashmir earthquake in 2005, thousands of copies of a simple poster explaining basic construction techniques were distributed to schools in the vulnerable region. The poster, designed by Roger Bilham of the University of Colorado and Rebecca Bendick at the University of Montana (the artwork is by her grandmother, Jeanne Bendick), packs a lot of information into a small space where the text — in English and Urdu versions — is almost secondary. You can download a 19-megabyte pdf copy here. (The National Science Foundation provided a grant for the poster project.)

Below you can see two of the panels from the poster depicting wise, and unwise, practices in seismic zones. Here's the quake-resistant approach:



Note how simple adjustments to the design — like including rings of reinforcing rebar around batches of the long reinforcing steel rods — matter enormously. In many of the collapsed schools in China's Sichuan province, rebar had such touches, but the circular "ties" were poorly done. (Have your kids tie some thread around a few pieces of uncooked spaghetti, then compare the strength of that array to a similar, but unbound, collection of pasta strands.)

Here's the illustration of dangerous choices:



Materials and methods matter enormously as well. Too much sand mixed with cement makes for crumbly concrete. Dr. Bilham noted in an e-mail message that information has to be tailored to the materials and methods favored in particular places. He recommends the Build Change Web site as another source. It has specific sets of recommendations for Indonesia and China, for example. In some cases, straw bale construction may be the right approach.

Education, in the end, is a vital part of limiting losses from inevitable hard knocks.

(Andrew C. Revkin, March 8, 2010)

Ideas for Spreading Quake-Resistant Building Methods

Design for Disaster

In the wake of my coverage of the hundreds of building collapses triggered by the powerful earthquake in eastern Turkey last weekend, Barry Welliver, a structural engineer based in Utah, sent a cogent amplification on ways to limit structure collapses in earthquake zones. His piece, posted as a Your Dotcontribution, relates to some of the images of earthquake wreckage I compiled (above) after the devastating 2008 quake in China's Sichuan province. Here's Welliver:

A local building official in Utah commented about how disturbed she was to see the twisted strands of rebar (concrete reinforcing steel) in photos of collapsed buildings in this quake and how concerned that made her for "un" reinforced structures. Indeed, even the use of reinforcing steel cannot assure safety.

You've hit upon a fundamental idea that is crucial to helping this cause (seismic safety of new and existing buildings). Buildings configured improperly will be "unknowns" in the earthquake test. Put more simply, engineers have not tested every arrangement of walls and floors to understand the consequences of every imaginable configuration, but there are some fundamental ideas which we can stand behind. Short cantilever columns above stiff in-fill panels perform poorly. Stacking two infill panels in one bay for the same cost of materials and forming a solid shear panel is a better concept.

Excellent resources for understanding preferred building layouts can be gleaned from the FEMA publication, Designing for Earthquakes: A Manual for Architects (FEMA 454).

Other resources for self-educating about the importance of construction types and techniques can be found at the Earthquake Engineering Research Institute's World Housing Encyclopedia.

There are some very basic concepts in structural building design which can be readily seen by the concerned observer. We should make it our business to promote safe practices and encourage solving problems in older buildings by pointing out these weaknesses. Daniel's video is a great start.

It's worth reposting something I wrote awhile back about a related design communication effort, undertaken in Pakistan after the devastating Kashmir earthquake in 2005. In this case, thousands of copies of a simple poster explaining basic earthquake-resistant construction techniques were distributed to schools in the vulnerable region.

The poster was designed by Roger Bilham of the University of Colorado and Rebecca Bendick at the University of Montana (the artwork is by her grandmother, Jeanne Bendick). It packs a lot of information into a small space (including simple cutaway views of columns showing the importance of where the text — in English and Urdu versions — is almost secondary. You can download a 19-megabyte pdf copy here. (The National Science Foundation provided a grant for the poster project.)

(Andrew C. Revkin, October 29, 2011, http://dotearth.blogs.nytimes.com/2011/10/29/ideas-for-spreading-quake-resistent-building-methods)

A Turkish Builder on Istanbul's Deadly Buildings

Istanbul is full of buildings vulnerable to a predicted earthquake.

Ali Ağaoğlu, a billionaire developer in Turkey, caused a stir last year when he admitted that his family's company – and most other developers –routinely used inappropriate materials during a building boom in Istanbulin recent decades, creating enormous vulnerability because of the long history of powerful earthquakes in the sprawling city.

I wasn't able to reach him when I researched my article on the city's efforts to limit losses when the next earthquake strikes (as it inevitably will), but we were able to talk a few days ago by Skype video. Mr. Ağaoğlu defended proposals to replace hundreds of thousands of shoddy structures with stronger buildings as part of a wave of gentrification, and warned other fast-growing cities in harm's way to adopt better planning and standards. Here's a transcript of our chat (carried out with the aid of a translator), with a few edits for clarity and compression:

Q.

For several years now I've been trying to understand ways to reduce vulnerabilities to earthquakes in big cities in developing countries, including Istanbul. Last year, in an interview with a Turkish newspaper, you spelled out clearly that it was normal, when many buildings were erected, to use materials that you would not use now. That's a difficult position to be in.

A.

I am 'coming from the kitchen' in this business, as we say, meaning all my family, under my father, were also a part of this sector, the construction sector. I grew up working with him, witnessing all of the development at that time. I'm not in a position to regret what I've said. The fact is that 70 percent of all the settlements in Istanbul, I would say, are vulnerable to a major earthquake. This is a diagnosis. Without the proper diagnosis treating a patient is not possible. The construction materials used for various settlements in different parts of Istanbul used to be of poor quality.

Q.

Is there anything that is not happening now that you think could reduce vulnerability quicker? Is there any glaring opportunity to make residents safer?

A.

There are a lot of things that can be done. Within the framework of the new urban transformation law, maybe we should also be transforming our directive on disaster planning and putting additional responsibilities on officials to develop new urban plans including these unfinished and illegal buildings in the law. Without waiting for an earthquake to hit vulnerable buildings we should be the ones to demolish them and rebuild. Since 2000, all new construction is super quality, maybe beyond the quality in many parts of the world.

Q.

One thing I heard from some people in Istanbul was why doesn't the government simply give each property owner money to fix up existing buildings. There are some who say the urban transformation law is just a way for banks and developers to get rich building new buildings instead of letting homeowners and property owners fix their own. Do you think they have any justification for that argument?

A.

Public money is being spent on public buildings that belong to the state. Here we're talking about the private sector. The replacement of those bad buildings that lack earthquake resistance has to be within the framework of the private sector. There is no need for the central government to be involved with that. The only exception is that the central government has to give authority to enact some urgent construction and development plans for certain areas and neighborhoods. This is necessary because Istanbul has been growing at tremendous speed with extensive migration from rural areas of the country. That was all carried out without the proper construction and development plans.

For the unsafe neighborhoods of the city, what can be done is to say there may be, say, 100 households that we regard as vulnerable. If there is a new development plan for that part of the city then a developer may go forward with construction of 150 units, where 100 units would be given to the owners of the weak apartments and 50 units go to the developer so he may also have an interest in the plan.

Q.

Hopefully the earthquake will wait, but it is, in the end, just a matter of time. I assume it's on everybody's mind that this could happen today or 30 years from now. That must weigh on you. Everybody in a city like Istanbul has to live with this. Is that a hard feeling?

A.

As a responsible person and professional, I've been continuously making warnings. In 1999, we had a major earthquake in a nearby city where more than 10,000 people lost their lives. And that part of country only equals a small neighborhood in Istanbul.

In a way we can say God has given us 10 years of credit since the last earthquake. Unfortunately, we seem to have spent those years in vain and have hardly done anything. Luckily an awareness has been created but still more actions have to be taken immediately so we can be more prepared.

Q.

There are many cities in other parts of the world that are now having the big population boom that Istanbul had all through the last several decades. What is your advice to builders in those places?

A.

I can recommend they take Turkey as an example and make observations about the development stages we have gone through [that resulted in thousands of poorly constructed buildings]. Unfortunately, there's no going backward, no compensation or remedy once this has taken place. Even if there is a remedy afterword it's costly from an economic perspective and in terms of the safety of people. I recommend proactive urban planning to prevent illegally constructed buildings ahead of time so this never takes place.

Addendum: There's a lot of fascinating background on the city's growing pains, and the lessons Istanbul holds in an age of urbanization around the globe, at the Web site of the Urban Age conference held there last year. In Istanbul and other cities with similar development patterns, there is rising class tension over large-scale gentrification efforts supported by developers eager to raze and rebuild and banks eager to expand mortgage markets. But in cities facing inevitable seismic disasters, it's hard to see another way forward.

(Andrew C. Revkin / Dot Earth - NEW YORK TIMES BLOG, March 18, 2010)

Amazing power of Japanese Tsunami caught on videos

Amazing power of Japanese Tsunami caught on video 11
https://www.youtube.com/watch?v=zwv1vzfFr_4

Amazing power of Japanese Tsunami caught on video 15
https://www.youtube.com/watch?v=3XNfK488ado

Amazing power of Japanese Tsunami caught on video 17
https://www.youtube.com/watch?v=AYRVYAqgJ1U&list=UL3XNfK488ado&index=23

Amazing power of Japanese Tsunami caught on video 19
https://www.youtube.com/watch?v=O259ajfJylM

The power of a Tsunami in Miyagi
https://www.youtube.com/watch?v=tDjfRKVN9LU

Japan Earthquake and Tsunami Song 2011: The Power In You https://www.youtube.com/watch?v=xgNayDQq_cw

Turkish Quake Highlights Need for Seismic Code Enforcement

The Chamber of Turkish Engineers and Architects says 40% of Turkeys housing needs to be reinforced or rebuilt to avert disaster in seismic events such as the one that struck the province of Van.

Scenes of collapsed buildings and rescuers pulling survivors from rubble once again show the acute need for seismic retrofitting and better- quality construction in Turkey.

A sense of déjà vu envelops Turkey at the start of November, with 601 dead, 4,151 injured and 3,713 buildings destroyed or uninhabitable as a result of a 7.2-magnitude quake that struck the eastern province of Van on Oct. 23.

The country lies in one of the world's most active seismic zones, perched on a web of numerous faults.

Many public buildings collapsed or were heavily damaged in the quake, including schools, dormitories, hospitals, clinics, police stations, courthouses and prisons. Damage to public facilities killed 60 teachers, two doctors and others and led to a mass prison breakout.

Multistory apartment blocks constructed of reinforced concrete with masonry infill make up as much as 80% of Turkey's urban housing and public buildings. The Earthquake Engineering Research Institute's 2003 study of housing in the country concluded that "lack of lateral resistance of the framing system resulting from poor design and construction is the principal reason for the poor performance of these buildings in recent earthquakes."

Paradoxically, Mete Sozen, a Turkish civil engineer and a structural engineering professor at Purdue University, West Lafayette, Ind., says, "Turkey has the most modern and up-to-date earthquake construction code in the world. … Unfortunately, codes are not uniformly enforced." He says reports indicate some of the felled buildings were built in the last five years and "should have been subject to the stringent codes."

Turkey's current code dates from 2007. Building codes and construction requirements are similar to those in California; however, lax enforcement means the codes are widely ignored.

Semih Tezcan, a professor of civil engineering at Bogazici University in Istanbul, estimates that 22,475 schools, 6,585 hospitals and 24,335 public buildings in Turkey are waiting to be retrofitted in first- and second-degree areas of risk, adding that more than 40 years and $66 billion would be needed. The Chamber of Turkish Engineers and Architects believes as many as 40% of existing buildings are illegal. The group estimates that to prevent a future earthquake from turning into a disaster, 10% of the total housing stock needs to be rebuilt and 30% retrofitted.

Istanbul, Turkey's business and cultural capital with an estimated 14 million to 15 million residents, is particularly vulnerable because of its location on the North Anatolian Fault. According to recent assessments, the probability of a major quake hitting there within 30 years is 62%. The likelihood of massive destruction within 10 years is as high as 32%.

The high threat level spurred the city to launch in 2006 an eight-year, $864-million project aimed at increasing Istanbul's resilience to a major earthquake. The Istanbul Seismic Risk Mitigation and Emergency Preparedness Project is jointly financed by the World Bank and European Investment Bank.

So far, 418 public buildings have been retrofitted or reconstructed, which is 76% of the project's original target of 550 buildings. An additional 69 buildings are being strengthened now. Retrofitting of 110 schools started in June 2010. The schools addressed so far serve about one million students and have more than 33,300 teachers. The hospitals strengthened and modernized to date serve more than 25,000 patients daily.

Istanbul also has created a digital inventory of its cultural heritage buildings. Designs for strengthening three historic buildings have been completed.

In the aftermath of the Van earthquake, Turkey's Prime Minister Tayyib Erdogan pledged to crack down on illegal buildings, promising, "We will not be concerned with losing votes by enforcing this policy." He said legal amendments would soon authorize the government to demolish shoddy buildings and compensate their owners as a solution to the country's chronic problem of substandard construction.

(Ann Uysal in Istanbul / Engineering News-Record, 11.07.2011, http://enr.construction.com/buildings/construction_methods/2011/1107-65279turkishquakehighlightsneedforseismiccodeenforcement.asp)

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In Earthquakes, Poverty, Population and Motion Matter

There are plenty of reasons damage and deaths from the 7.1-magnitude earthquake that struck near Christchurch, New Zealand, on Saturday utterly paled compared to the absolute devastation wrought by the 7.0-magnitude quake near Port-au-Prince, Haiti. I sent a query about the different outcomes in Christchuch, Haiti (and Chile) to a half dozen engineers and geologists working on earthquake preparedness and design and you can read some of their observations below.

Here are some of the main points:

- Poverty kills.

- Not all earthquakes of the same magnitude have the same destructive force. Ground motion is a critical factor. Check the two charts below for a comparison of the motion of the earth in New Zealand and Haiti. No competition.

- Communities and countries that have frequent low-level seismic activity (New Zealand, Japan, California) tend to have better construction standards and preparation than those where quakes are devastating, but rare (Haiti, the Pacific Northwest).

Below you can compare tables showing the intensity of ground motion in communities around the epicenters in New Zealand and Haiti. Click here for descriptions of the rankings. Basically red and orange are very bad. (Santiago Pujol of Purdue University sent the charts, which are from the U.S. Geological Survey.) Also look at the populations in the two quake's danger zones.

New Zealand

Exposure Summary | Full City Exposure List | Downloads

MMI	City	Population
VIII	Darfield	2k
VII	Burnham	1k
VI	Rolleston	3k
VI	Rakaia	1k
VI	Leeston	1k
VI	Lincoln	2k
V	Oxford	2k
V	Christchurch	364k
V	Methven	1k
V	Woodend	3k
V	Amberley	1k
IV	Oamaru	13k
IV	Pleasant Point	1k
IV	Timaru	28k
IV	Greymouth	9k
IV	Westport	4k
IV	Hokitika	3k
III	Brightwater	2k
III	Blenheim	27k
III	Wakefield	2k
II	Wanaka	4k

Here's are several reactions from experts in earthquake risk, starting with John Mander, a Christchurch native teaching at Texas A&M University.

John Mander:

Christchurch is my home town. I received my PhD in seismic design in the 1984 from the University of Canterbury in Christchurch, NZ. I am a structural engineering professor and conduct research in earthquake engineering and other hazards.

Of any place in the world, this would probably be the best prepared. The City council many years ago in the 1970s started upgrading programs for earthquake prone buildings. In spite of that there is a shocking amount of damage, but that can generally always be attibuted to historic non-engineered construction. That is construction built by convention, was conforming to building codes of the day, but these have historically not had any earthquake resistance provisions. There are reports of unliveable modern houses in a seaside suberb, Bexley. I suspect this is attributed to the foundations and specifically liquefaction and ground failure.

Haiti

Exposure Summary | Full City Exposure List | Downloads

MMI	City	Population
IX	Gressier	26k
IX	Carrefour	442k
IX	Leogane	134k
VIII	Port-au-Prince	1,235k
VIII	Petionville	283k
VIII	Delmas 73	383k
VIII	Grand Goave	49k
VIII	Petit Goave	118k
VIII	Croix des Bouquets	229k
VIII	Miragoane	89k
VIII	Kenscoff	42k
VIII	Cabaret	4k
VII	Fond Parisien	18k
VII	Jacmel	138k
VI	Cotes-de-Fer	2k
VI	Cayes Jacmel	2k
VI	Fond des Blancs	3k

I am not so familiar with the recent Chile event, but compared to Haiti, where all the construction was heavy non-engineered systems that fared somewhat better.

The lesson in all of these events is pretty much the same:

- Well engineered structures are less damage prone, but it should be noted they are NOT earthquake proof! Engineers will now take some time to inspect the high rise buildings, as they may be hiding signs of damage behind their ceilings or facades. Of particular concern will be beam-column joints. It is too soon to tell whether some of these will need repairs, even though they may be fine. Housing that consists of unreinforced masonry, particularly bricks, and any other heavy materials are more damage prone than engineered structures.

- The type of construction that has evidently suffered the most is the older commercial structures that fit between the above two categories, specifically two-storey shops that have a brick frontage, and either wood-frame brick veneer or sometimes all-brick back. The front generally has not been well tied to the back the main structure, that is why it simply peels off during shaking. Many of these structures were built in the late 1800's and up to the depression. Commonly there was retail downstairs and living upstairs. Because many of these failed were within the CBD, they are now rarely used as living accommodation. It was fortunate that the earthquake did not occur on a weekday, as it would have been more likely to get casualties. Building styles changed after WW2 due to the need for more rapid construction, the high cost of bricks, and of course the bad experiences of brick buildings in the 1931 Napier Earthquake.

- When there are signs of large ground movement, fissures, surface water, there is a high chance the sub-surface utilities, such as water and sewerage piping may have sustained breakages. Christchurch decommissioned its old town [coal] gas several decades ago, that is why it is unlikely there would be any fire spread.

Peter Yanev:

Construction, in general, in Christchurch is very similar to California construction. Much residential wood frame. The new buildings have good quake designs, unlike absolutely no design in Haiti. The older buildings are wood frame (pretty safe) and some are, just like in California, unreinforced brick. The media is showing mostly partial collapses to those kinds of buildings. Nothing surprising there. However, at first impression, the ground motion in the city is significantly weaker than the worse parts of Port-au-Prince. That is primarily due to the distance of the faulting (weaker ground motion). Therefore one should expect much less damage proportionally on both accounts – further away from the very strong motion and better construction.

I have a feeling that as we get the strong motion records, we will see that the Haiti quake was much worse because of stronger ground motion where the people were and much weaker construction (i.e. no earthquake resistant design and generally poorer quality of construction and construction materials – no wood).

Kit Miyamoto:

We found that New Zealand was prepared for this earthquake by engineering capacity, code, and emergency response. It is definitely advantageous to have frequent earthquakes. It makes the society aware of the risk. It makes the construction and engineering practice better. On the other hand, the last major earthquake in Port au Prince was in the mid 1700's. Society forgot about the earthquake risk and was not prepared for it. Many so called engineered structures also collapsed because there were no earthquake resistive system. We saw the same thing in Sichuan, China in 2008. They thought they were immune from the earthquakes. It killed 90,000 people including thousands of students in classrooms. In Haiti, I still find the dead bodies buried in the collapsed buildings. So I think the estimation of 230,000 death is underestimated. I believe both Sichuan and Haiti will change their practices. But it is too late for these 320,000 people and children who died. There are many parts of the world like this, including many cities in the US where earthquakes are not a current concern. I think that's why it's so important for engineers to communicate and educate the public about earthquake risks.

(Andrew C. Revkin / Dot Earth - NEW YORK TIMES BLOG, September 7, 2010)

Designing for Safety in Turkey and Other Earthquake Zones

Residents of Van, Turkey, search a collapsed building for survivors of an earthquake.

The latest earthquake in Turkey — that country's strongest in a decade — provides a fresh reminder of the deep vulnerability created by weak building designs in the world's crowded seismic danger zones. There will be more horror to come there and in other places prone to powerful quakes.

But don't be tempted to write off high death counts from building collapses in shaky developing countries as simply another unavoidable consequence of poverty. There are designs suitable for schools and other structures that are fundamentally stronger than those typical in such regions and only require configuring common materials in different ways.

I've written here often about one such design, by Santiago Pujol of Purdue University. Now I've posted a freshly edited video (incorporating an animated graphic by my elder son, Daniel) that conveys how simply rearranging the same batch of bricks, columns and windows can create a resilient structure on a budget.

So there's no difference in cost or materials. All that's needed is awareness and motivation. [Oct. 24, 5:17 p.m. | Updated | The head of the office of the International Strategy for Disaster Reduction, a United Nations body, has said that the collapse of almost 1,000 buildings "underlines the importance of providing the right incentives and information to builders and [property] owners in the world's most dangerous earthquake zones."]

The Open Architecture Network is one experiment in getting smart designs where they need to go. I'd love to know of more.

And of course this issue is hardly restricted to poor regions of the world. There's plenty to do in shaky wealthy places, as well, with Oregon being a glaring case in point.

(Andrew C. Revkin / Dot Earth - NEW YORK TIMES BLOG, October 23)

The death toll from the Christchurch earthquake was low, whereas the Haiti earthquake (below) killed over 300,000 people, owing to poor building standards

Engineering for earthquakes

The principle of engineering structures for an earthquake zone is a simple one: 'Earthquakes do not kill people, structures do."

Unsurprisingly, when large earthquakes happen in remote locations the human death toll is often close to zero with minimal economic impact. When large earthquakes happen in built up places, the results are far more variable. In locations such as California, Chile, Japan or New Zealand the number of people killed is generally small, but in other locations (China, Pakistan, Haiti) the death rate is often very high because the housing stock isn't as earthquake resistant.

Economic losses tend to be larger for the places with low death rates, but expressed as a percentage of Gross National Product (GNP) the impact for these location is still generally small. Where the death rate is high the dollar cost is usually low but astronomical as a percentage of GNP. For example the direct losses from the 1989 Loma Prieta earthquake in San Francisco were ~8.0 $bn but this was only a 0.2% loss in GNP of the USA. Conversely the recent earthquake in Port au Prince, Haiti, cost 7.9 $bn which represents a 120% loss in GNP.

Earthquakes since 1900 with death toll > 50,000 (USGS)

Date	Location	Deaths	Magnitude
1908/12/28	Messina, Italy	72,000	7.2
1976/07/27	Tangshan, China	242,769	7.5
1920/12/16	Haiyuan, Ningxia, China	200,000	7.8
1923/09/01	Kanto, Japan	142,800	7.9
1948/10/05	Ashgabat (Ashkhabad), Turkmenistan	110,000	7.3
1990/06/20	Western Iran	50,000	7.4
2005/10/08	Kashmir, Pakistan	86,000	7.6
2008/05/12	Eastern Sichuan, China	87,587	7.9
2010/01/12	Port au Prince, Haiti	316,000	7.0

Yet we know where the seismically prone regions are in the world; we also know how to make good construction materials and how to design and build earthquake resistant structures. So what is going wrong?

When earthquake death rates are very high it is because we have built many structures that collapse and kill their inhabitants even when moderate earthquakes occur. We build fast, thinking we are doing a great job. After all, we are providing housing as part of the global urbanisation process. However, I would argue that we are still building too many structures that will turn into graves because they will collapse and kill.

Roger Bilham, Professor of Geological Sciences at the University of Colorado at Boulder, has identified megacities that are threatened by a major disaster. These include Bogotá, Cairo, Caracas, Dhaka, Islamabad, Istanbul, Jakarta, Karachi, Katmandu, Lima, Manila, Mexico City, New Delhi, Quito, and Tehran.

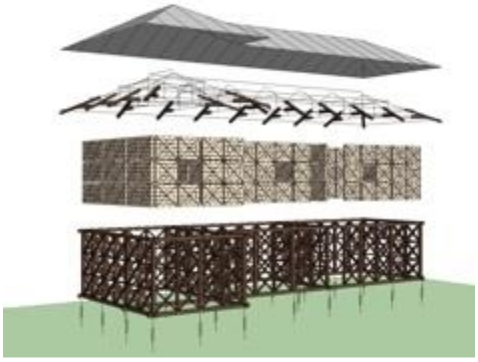
Yet such disasters will not be natural disasters, not 'black swan' events. They will be man-made and will be a painful way to highlight our misplaced values.

To ensure we do not leave a legacy of unacceptable quality building stock for the next generation, speed and cost of new builds must be balanced by caution in the planning and design process. Seismic design may add to the workload, but it is too important to ignore, especially in areas experiencing rapid population and economic growth.

This building, an example of vernacular architecture in Pakistan, was analysed by Arup to determine its seismic performance (images below). Over 100,000 such buildings were erected following the 2005 earthquake.

How much?

Using data from the World Bank and some simple assumptions we can estimate the yearly annual need for housing in earthquake prone regions. The population growth in seismic regions is approximately 53million — about the population of the UK — per year. These people need homes. If we assume an average of 100m2 to house five people at a cost of five times the estimated average annual income of £6,300 the annual new construction budget could be in the region of £334billion.



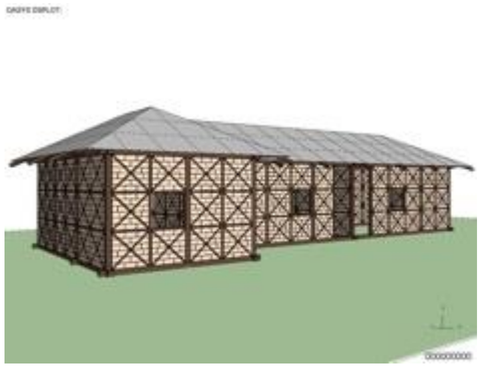
If we could earmark just 0.1% of the annual construction cost to promoting earthquake safety that would amount to £6.30 per new person per year. If we spread the monies further over the existing total global population the cost would be as little as seven pence per person per year.

Why don't we find the many seven pence needed to make a difference?

To not do so sends an unpleasant message to the next generation: that forward planning and recognizing the consequence of one's legacy do not matter in certain places.

Engineers can make a difference. How about:

1. Training to roll out disaster risk reduction engineering health campaigns,
2. Including earthquake engineering on every syllabus of every civil and structural engineering course,
3. Taking implementation seriously – train masons, carpenters, steel fixers, welders, home owners, policy makers, government officials, new students, practicing engineers and architects,
4. Developing an app for seismic design of typical structures - we know that mobile phones are becoming ubiquitous throughout the developing world and this would increase accessibility to information and knowledge of seismic design,
5. Create partnerships with mobile phone operators to collect donations from their customers to fund this.



Engineers and architects are the custodians of the built environment and it is time we showed leadership and made engineering safety a priority. Are we seriously investing all this money to see it crumble apart in 30 seconds?

Hope alone will not get us to where we need to be. I am sure we can do better.

(Kubilay Hicyilmaz / theengineer, 3 November 2011, https://www.theengineer.co.uk/issues/november-2011-online/engineering-for-earthquakes)

Purdue experts try to help quake-tossed Turkey

Improving seismic design of Turkish buildings will be key in saving lives during future earthquakes.

That's the goal of Purdue University civil engineer Ayhan Irfanoglu, who traveled to his native country of Turkey recently to study why hundreds of buildings collapsed in the area of Ercis, Turkey, during an earthquake last month.

Last month's magnitude 7.2 quake and a magnitude 5.7 quake last week flattened some 2,000 buildings, killed 644 people and left thousands homeless in the eastern province.

In the past 24 hours, the same region in Eastern Turkey has experienced three more earthquakes ranging in magnitude from 4.6 to 5.2. The largest and most recent occurred at 5:08 p.m. EST Monday. No immediate damage was reported, according to the Associated Press.

Rescue workers search for survivors in the rubble of a collapsed hotel Saturday in Van, Turkey.

"We want to help people understand how to construct buildings the right way, so they don't collapse," said Irfanoglu, who is part of an Earthquake Engineering Research Institute rapid response team.

Design flaws documented during the trip clearly indicated why so many buildings failed, Irfanoglu said. Issues discovered included multistory buildings where the first floor, typically a business, was built too high to carry the structure's weight. In these buildings, the first floor would simply collapse.

In others, columns would be "blocked" by structures, preventing them from bending. Then the columns would snap.

Or lateral load-resisting walls or other elements were not distributed properly over the structure, causing the building to twist from the ground vibrations.

These flawed buildings aren't the result of cutting corners, Irfanoglu said, but lack of understanding.

"These contractors sometimes live in this buildings. Their parents, their families live in them. You wouldn't stick your family in a building that looks shoddy. It is simply a lack of understanding, a lack of knowledge. I think that is the main culprit."

Purdue civil engineer Mete Sozen, who helped write Turkey's construction codes addressing earthquake preparedness and has proposed a plan to protect highly vulnerable Istanbul, has stated that Turkey's codes are not uniformly enforced.

To improve construction, Irfanoglu would like to see seminars held to better educate municipalities, foreman and buildings.

He and others also want to change the building code from 159 pages to less than 10 pages.

"We want to create simple guidelines so they know how to check it, how to build it," he said. "When someone use this very sophisticated code, it is a rather difficult job to review it."

But, for now, Irfanoglu and others can only make suggestions to agencies and Turkey.

As part of the research trip, reports will be written to the National Science Foundation and EERI.

The research trip was sponsored by the George E. Brown Jr. Network for Earthquake Engineering Simulation. The network, a collaborative effort involving 14 university research facilities and other public and private partners, has its headquarters at Purdue.

Very few state-owned buildings in the provincial capital, also called Van, survived the quake, provincial Gov. Munir Karaloglu told the state-run Anatolia news agency. Many have left the city because they fear going back into their homes even if they are not damaged.

"It is a ghost city," Karaloglu said. "Almost none of the buildings are in use."

Irfanoglu said some people he spoke to earlier this month were afraid to sleep in their homes if cracks were visible in the walls, even if the building was structurally safe.

Others would ask him if a building was safe enough to quickly enter to collect their belongings and then leave.

"They have nowhere to go, just out into the street," Irfanoglu said.

Several countries, including the United States and Israel, have sent in tents and prefabricated homes. But misery and death are constant companions.

According to The Associated Press, the HaberTurk newspaper reported that a 7-year-old disabled girl who had been living in a makeshift tent died of pneumonia in Ercis on Sunday. Her father claimed that he could not obtain a proper tent from authorities, the newspaper reported.

Amidst the tragedy and loss, Irfanoglu is optimistic that reform and understanding of construction codes will become a national focus.

If the earthquakes had not happened, he said, years of shoddy building could have continued in Ercis and lead to thousands of deaths in a future earthquake.

"In a sense, nature caught up with them very quickly," he said. "It really shows that nature never favors anyone. It shows your weaknesses and irrationalities. If anything is hidden, this reveals the mistakes.

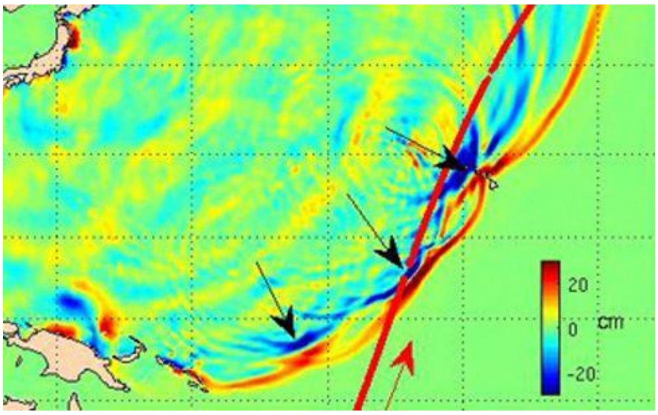
"We just hope people will learn from these mistakes."

(Eric Weddle / The Associated Press, Nov. 15, 2011)

Διπλό χτύπημα
Από τη συνένωση δύο κυμάτων σχηματίστηκε το τσουνάμι της Ιαπωνίας

Το υδάτινο τείχος που σάρωσε τις ακτές της βορειοανατολικής Ιαπωνίας σχηματίστηκε από το συνδυασμό δύο επιμέρους κυμάτων, φαινόμενο που είχε προβλεφθεί θεωρητικά αλλά δεν είχε επιβεβαιωθεί μέχρι σήμερα, αποκαλύπτουν δορυφορικά δεδομένα που ανέλυσε η NASA.

Τρεις δορυφόροι που έτυχε να περνούν πάνω από τον Ειρηνικό λίγες ώρες μετά το σεισμό κατέγραψαν τη συμβολή δύο κυμάτων που είχε ως αποτέλεσμα το σχηματισμό ενός νέου κύματος με διπλάσιο ύψος.



Τα επιμέρους κύματα που σημειώνονται με τα βέλη συνδυάστηκαν για να σχηματίσουν ένα νέο κύμα διπλάσιου ύψους (NASA/JPL-Caltech/OSU)

«Η πιθανότητα να μπορέσουμε να καταγράψουμε αυτό το δι-πλό κύμα με δορυφόρους ήταν μία στα δέκα εκατομμύρια» εκτιμά ο Τόνι Σονγκ του Εργαστηρίου Αεριώθησης (JPL) της NASA στην Καλιφόρνια.

Όπως ανέφερε ο Σονγκ στο συνέδριο της Αμερικανικής Γεωφυσικής Εταιρείας, η ανάλυση προσφέρει μια εξήγηση για το πώς τα τσουνάμι προκαλούν εκτεταμένες ζημιές σε ορισμένες περιοχές ενώ αφήνουν άλλες σχεδόν ανέπαφες.

Όπως δείχνουν τα δορυφορικά δεδομένα και επιβεβαιώνουν τα μαθηματικά μοντέλα του JPL, τα υποθαλάσσια βουνά και γενικότερα η τοπογραφία του ωκεάνιου πυθμένα εκτρέπουν κατά τόπους το αρχικό κύμα που προκαλεί ο σεισμός, δημιουργώντας επιμέρους κύματα που είτε συνεχίζουν να κινούνται ανεξάρτητα ή συγχωνεύονται σε άλλο σημείο.

«Οι ερευνητές υποψιάζονταν εδώ και δεκαετίες ότι τέτοια "συνδυαστικά τσουνάμι" [merging tsunami] ενδέχεται να βρίσκονταν πίσω από το τσουνάμι της Χιλής το 1960, από το οποίο σκοτώθηκαν 200 άνθρωποι στην Ιαπωνία και τη Χαβάη. Μέχρι σήμερα, όμως, κανείς δεν είχε παρατηρήσει ένα τέτοιο συνδυαστικό τσουνάμι» αναφέρει ο Σονγκ.

Η έρευνα βασίστηκε σε δεδομένα από τους αμερικανο-ευρωπαϊκούς δορυφόρους Jason 1 και 2 και τον δορυφόρο Envisat της ESA (Ευρωπαϊκή Υπηρεσία Διαστήματος). Και οι τρεις δορυφόροι φέρουν αλτίμετρα, όργανα που μετρούν το ύψος της επιφάνειας των ωκεανών με ακρίβεια λίγων εκατοστών.

Περίπου 7,5 ώρες μετά το σεισμό των 9 βαθμών, ο δορυφόρος Jason 1 κατέγραψε τα δύο επιμέρους κύματα την ώρα που συγχωνεύονταν. Οι δύο άλλοι δορυφόροι πέρασαν πάνω από την ίδια περιοχή λίγο αργότερα και παρατήρησαν μόνο ένα ενιαίο κύμα.

Η έρευνα υποδεικνύει ότι για την εκτίμηση του κινδύνου από τσουνάμι οι υπεύθυνοι πρέπει να λαμβάνουν υπόψη την τοπογραφία μιας πολύ μεγάλης θαλάσσιας περιοχής, και όχι μόνο το ανάγλυφο του βυθού λίγο έξω από τις ακτές.

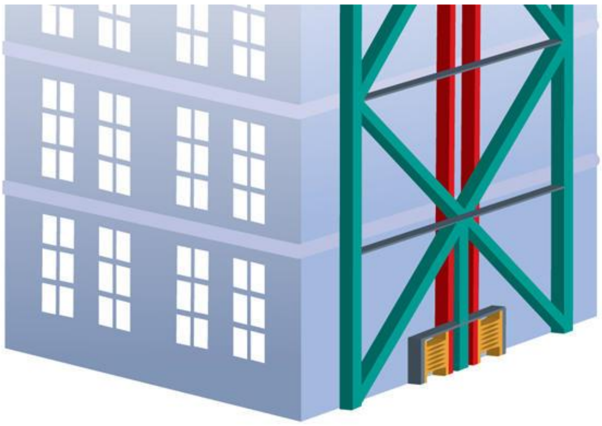
Όπως αναφέρει η ερευνητική ομάδα «μπορούμε να αξιοποιήσουμε αυτά που μάθαμε ώστε να προβλέπουμε καλύτερα τον κίνδυνο τσουνάμι σε συγκεκριμένες παράκτιες περιοχές, ανάλογα με την τοποθεσία και τον μηχανισμό του υποθαλάσσιου σεισμού».

(Newsroom ΔΟΛ / 06 Δεκ. 2011, http://www.in.gr/2011/12/06/tech/apo-ti-synenwsi-dyo-kymatwn-sximatistike-to-tsoynami-tis-iapwnias)

To save buildings from quakes, architects try self-destruction by design

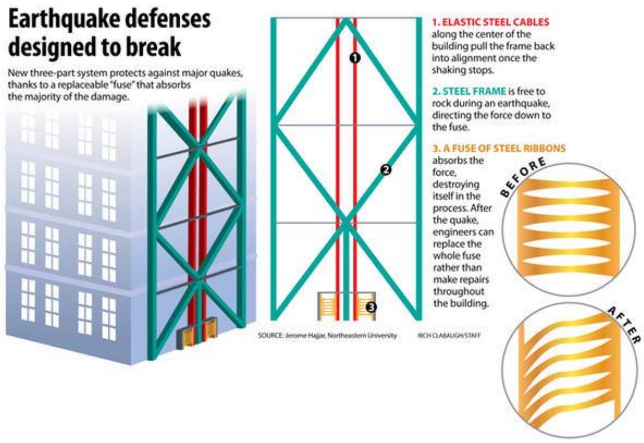
Architects hope to protect buildings by letting them rumble instead of crumble. A new design feature would sacrifice itself during an earthquake without harming anything else.

Earthquake building codes aren't really designed to save buildings. Engineers need to protect occupants, but there's no rule that buildings should withstand earthquakes of any particular magnitude.



An architectural "fuse" could save buildings during earthquakes. See graphic, below, for more details. Rich Clabaugh/Staff

"Perfectly good buildings may need to be condemned after an earthquake, simply because that's how we're designing them – because we think that's economical," says Jerome Hajjar, chair of the Department of Civil and Environmental Engineering at Northeastern University in Boston.



Dr. Hajjar and his team think earthquake engineers can do better. They developed a new method for defending buildings not just from collapse, but also from the tiny fractures and warps that make structures unsafe after a quake and very expensive to repair.

Their secret: self-destruction by design.

The scheme directs the force of an earthquake to a "fuse" that sacrifices itself to save the rest of the building. The seismic force irrevocably destroys the steel fuse. But since the damage is contained to only one part of the building, engineers can simply remove the ruined fuse and replace it with another.

The fuse itself is a sheet of high-caliber steel with diamond shapes cut out of the center. These holes turn the plate into powerful ribbons that writhe under extreme force, absorbing the impact. (See graphic.)

Fuses are not new to earthquake engineering. Some builders install protective braces that warp and wear as the structure shakes. The drawn-out process of inspecting and replacing each damaged brace, however, leaves a building "weaker than you would like it to be," says Ronald Hamburger, a structural engineer with Simpson Gumpertz & Heger in San Francisco and not part of Hajjar's team.

These new fuses are self-contained, making them much easier to replace without compromising the structure. Hajjar says this will keep repair costs minimal and should stop some owners from deciding it would be cheaper to demolish a rattled building rather than find and repair each fracture.

Hajjar and fellow team leader Gregory Deierlein at Stanford University in California designed two more elements that complement the fuse.

First, the steel frames that normally resist earthquakes may rock free of the foundation, shaking side to side like a chair with uneven legs.

"If you tie them down, columns or the braces that are at or near the base are more likely to absorb the energy from the earthquake," he says. This rocking design instead protects the integrity of the frame by passing the buck on to the attached fuses.

The other innovation: vertical cables that run the height of the building. These taut but elastic steel cords realign each floor after a seismic shake. "The system is designed to self-center after an earthquake, while typical buildings are prone to 'story drift,' " where structures settle off-kilter, says Mr. Hamburger.

For example, the California State Automobile Association headquarters remained standing after the 1994 Northridge earthquake. But the 6.7-magnitude tremor caused such a permanent skew that the building was condemned soon after. These vertical cables could immediately correct the drift.

But this three-part system comes with several drawbacks, according to Hamburger – not in its design, but in the realities of modern construction work.

"Their system is something of a Swiss watch," he says. "It takes care; it takes training. Not just anyone can build it." This makes contracting more expensive. Because major earthquakes are still rather rare – and American buildings often change hands relatively quickly – Hamburger says few developers will bother paying to implement such safety features. Exceptions include government agencies, hospitals, universities, and corporate headquarters – institutions that plan to remain in one place for decades.

The other problem could fix itself within four to 10 years. That's how long it is likely to take for Hajjar and Dr. Deierlein's plan to enter American building codes, according to Hamburger, who for 10 years chaired the Building Seismic Safety Council's Provisions Update, the group that writes the earthquake provisions in the International Building Code.

Interested engineers can already use fuses, rocking frames, or vertical cables. (Hajjar says two buildings in Illinois already do.) But getting approval for such designs requires a persistent developer and an open-minded local building authority.

Hajjar and Deierlein are still testing and refining their three-part plan. In 2009, the team put a prototype three-story building through a magnitude-7 tremor at Japan's E-Defense, the largest earthquake simulator in the world. The frames rocked. Steel fuses warped. Vertical cable held strong – exactly as planned.

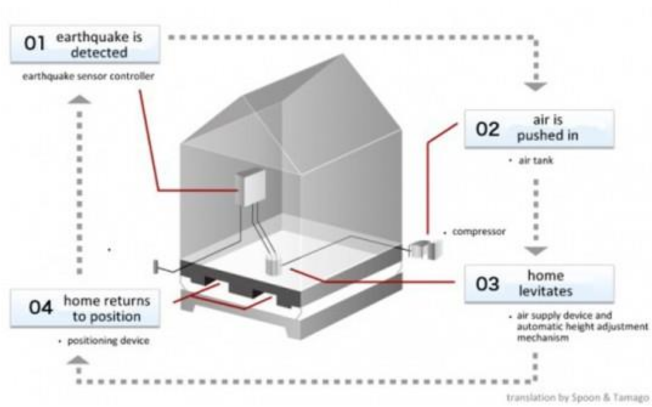
"We continue to explore new ideas, better configurations, and better materials," says Hajjar. "We're doing this to create a better system not just for owners, but for occupants. Because owners know what they're buying but occupants don't always know that a significant event could cause significant damage to the point where a building can't be repaired or isn't worth being repaired."

(Chris Gaylord / THE CHRISTIAN SCIENCE MONITOR, January 13, 2012, https://www.csmonitor.com/Technology/Tech/2012/0113/To-save-buildings-from-quakes-architects-try-self-destruction-by-design)

cs ✻ so

Japanese Levitating House System Could Protect Homes from Earthquakes

We've seen quite a few creative examples of disaster-resistant architecture here at Inhabitat – from houses that rise up atop flood waters to an elastic iron alloy designed to sway with an earthquake. Now a Japanese company, Air Danshin Systems Inc., has come up with perhaps the most inventive solution we've seen — they fit out existing houses to levitate in the event of an earthquake. In the wake of last year's Fukushima disaster the company is set to install the levitation system in 88 houses across Japan.



As fantastical as a home levitation system may seem, Air Danshin claims that the technology is not only effective, but also 1/3 cheaper than many other earthquake-proofing systems out there – and it requires little maintenance. According to Spoon & Tamago, the technology calls for a fairly simple, if powerful, set of mechanisms to be installed around a property. When an earthquake hits, a sensor responds within one second by activating a compressor, which forces an incredible amount of air under the home, pushing the structure up and apart from its foundation. The air pressure can keep the home levitating up to 3cm from the shaking foundation below. An indoor valve controls the flow of air under the house, keeping the structure steady as it "floats."

Once the earthquake is over the home gently falls back onto an earthquake-resistant reinforced concrete foundation. While the earthquake-resistant levitation system is presently being installed in houses, we hear the Japanese firm hopes to expand to install the system in larger, potentially more critical structures. To promote the technology, Air Danshin Systems have made some fairly convincing, and somewhat humorous, videos to demonstrate their technology in action.

(Charley Cameron / Inhabitat, 29.02.2012, http://inhabitat.com/japanese-levitating-house-system-could-protect-homes-from-earthquakes)

Can you quake-proof a building?

Sifting through the rubble in Christchurch.

EARTHQUAKES are a force to be reckoned with in Australia even though they tend to fly under the radar, according to civil engineering academic John Wilson. Having focused on quake engineering here and overseas, including in high-seismic California, he and Swinburne University researchers are using the $15 million Smart Structures Lab to simulate quake forces and develop safer buildings.

What is Australia's quake risk?

People tend to think we don't get earthquakes in Australia. We don't get the big ones - magnitude eight or nine - but we get a magnitude-five every year somewhere in Australia, a magnitude-six every five years and a magnitude-seven probably every 50 years. It is a matter of whether it's out in the middle of nowhere or a bull's-eye hit near a city where they cause great damage, so I'm looking at buildings and how much drift they can take before they collapse.

Why focus on building drift?

With an earthquake, it's not so much the quake that kills the building but more that gravity takes over and the building collapses as a result. It's only when the quake has displaced the building too far laterally, or horizontally, that all of a sudden the columns and walls no longer tolerate those drifts.

Does this field warrant more research?

Yes. Historically, all around the world, we've gained a pretty good grip on how strong buildings are for resisting gravity loads and horizontal loads. But in an extreme quake, the forces go beyond what buildings are designed for, so the question is: how much drift can they tolerate?

How will you use Swinburne's lab?

This project I'm working on is involved with testing medium-rise commercial buildings. We're not going to do a full-scale test of forces on a building inside that lab, but we will test critical components to get a better idea of how they behave. We'll be pushing those walls over to see if we get 1 to 2 per cent drift out of those walls. And we're using large forces! In that lab, we can test up to about 500 tonnes. Then we'll build the results from the component tests into computerised analytical models to get a macro view of the way the building's going to behave.

The lift shaft is integral in this regard?

Yes. In your typical medium-rise city building, around the lift shaft you've got a big concrete wall, which is there for fire protection in part, but from our point of view it provides the spine of the building - and the resistance to lateral loads.

What are the benefits of being able to use the simulation facility?

Nowadays the analytical models are pretty sophisticated, but you need to calibrate them against reality. So the integration of digital and physical models will greatly improve the accuracy of the results and our confidence in them.

Will it be possible to quake-proof a building?

Definitely. We've got the technology now! The best is what we call ''base isolation'' of buildings: we actually put buildings on springs or rubber bearings. It decouples the motion of the building from the ground. These springs are like bridge bearings: a rubber bearing with a laminated steel plate. So it's steel plate, then rubber, steel plate, then rubber - a bit like one of those old striped liquorice all-sorts blocks. That makes it very stiff vertically but quite flexible horizontally, so when the ground shakes the building lurches back and forwards. The advantage is the building doesn't really get damaged. You can operate your business tomorrow out of that building.

Is it very expensive?

It probably adds about 5 per cent to the building cost. It's great for buildings up to about five storeys. You see a lot of hospitals around the world now with this technology … and museums, where you've got a lot of very valuable contents that you don't want damaged.

(Deb Anderson / The Age (Melbourne, Australia), March 13, 2012, http://www.theage.com.au/national/education/can-you-quakeproof-a-building-20120312-1uubg.html)

Safer designs affordable - expert

NEW WAYS: Canterbury University concrete design engineer Des Bull says buildings should be designed and built differently in future.

Technology to help new buildings in Christchurch survive earthquake damage is affordable, a structural engineer says.

New technology for the central-city rebuild was yesterday discussed before the Canterbury earthquakes royal commission.

Low-damage designs discussed included base isolation – a design method that allowed a building to move on its base and absorb ground shaking – and precast seismic structural systems (Presss), which allows controlled rocking of a structure's joints.

Engineering company Structex designed the endoscopy unit at Christchurch's Southern Cross Hospital using Presss technology.

Director Gary Haverland told commissioners the building, completed in August 2010, used precast concrete walls and post-tensioned frames.

The build was $30,000 under the $7.2 million budget and was completed ahead of schedule.

The February 2011 quake caused "minor" cosmetic damage, and Haverland believed the structural system performed well.

Structural engineer John Hare, of Holmes Consulting Group, said new building technology was "well established but not well used".

Holmes had designed six buildings using base isolation at a rate of one about every five years.

"Assuming we ask ourselves the question and do want better performance from our buildings, we have to ... be sure the new technologies we go to are actually going to perform better, otherwise we might repeating some mistakes of the past," Hare said.

The existing technology "hasn't really let us down".

"If a building was regular, well-conceived, well-detailed, well-constructed and on good ground, by and large it's performed very well even though it's been through loads potentially up to twice what they were designed for," he said.

Des Bull, a professor of civil and natural resources engineering at Canterbury University, told the commission design changes were needed.

"The whole issue is should we continue to build conventional buildings as they've done for 30 years? Personally, I don't think we should," he said. "There are plenty of options with new technologies for future buildings just to rearrange the connections between the walls, beams, columns and foundations such that we don't have these intrinsic, systemic problems that we have with all our current building stock," he said.

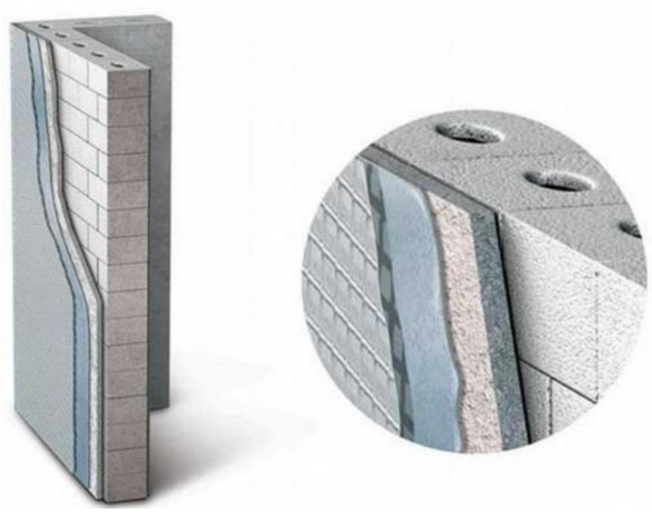
Damage to building connections could not be repaired in most cases and resulted in demolition, Bull said.

The effect was like bending a paperclip until it snapped.

"They might be able to survive a subsequent series of smaller aftershocks, but could they survive another major event in the next 20 or 30 years? Highly unlikely, and that's some of the reasons these buildings have been brought down. They have nothing left in them to resist big earthquakes and are too expensive to repair," Bull said.

(Marc Greenhill / Stuff (New Zealand), http://www.stuff.co.nz/national/christchurch-earthquake/6569581/Safer-designs-affordable-expert)

High-tech wallpaper resists earthquakes



Credit: Karlsruhe Institute of Technology

German researchers say they've developed "seismic" wallpaper that can hold a masonry wall together to keep it from crumbling or falling in an earthquake.

Scientists at the Institute of Solid Construction and Construction Material Technology at the Karlsruhe Institute of Technology used stiff, high-strength glass fibers woven together to form a strong elastic covering, with the fibers running in four directions to distribute energy evenly when the walls are shaking, Deutsche Welle reported.

The special wallpaper is adhered to walls with a flexible, soft adhesive made from water and a large amount of polyurethane beads.

After the adhesive penetrates the masonry the water evaporates and the beads strongly anchor the material to the wall, the researchers said.

The seismic material was tested on a replica house in an earthquake simulator.

"Because of the earthquake wallpaper, we were unable to make the building collapse," researcher Mortiz Urban said.

The wallpaper will start going into commercial production this year, researchers said.

(UPI, April 4, 2012, http://www.upi.com/Science_News/2012/04/04/High-tech-wallpaper-resists-earthquakes/UPI-11931333589780/#ixzz1rBcLTINe)

Engineers' earthquake simulation ready to roll

Intricate structure at UC San Diego facility will undergo severe tests (U.C.S.D.'s Engelkirk Structural Engineering Site on Pomerado Road, just east on Interstate 15).

One of the biggest efforts ever made to understand how earthquakes affect buildings begins Tuesday at UC San Diego, where engineers will violently shake a five-story structure fitted with 500 sensors and 70 cameras.

The test is the first in a series meant to help scientists improve building codes and prevent fires, a common aftereffect of quakes.

S.D.S.U. graduate student Elias Espino explains the function of one of the 5 story building's "base isolators" that support the building.

Scientists have shaken the skeleton of buildings before, but this is a complete mid-rise with electrical systems and a working elevator. The top two floors have been designed as a mock hospital, complete with a surgical suite and an intensive care unit. It is the most elaborately detailed quake test building ever created.

A 200 pound of piece of concrete, to simulate a person, was placed on this hospital bed on the 5th. floor of the building to simulate an operating room. At left is S.D.S.U. graduate student Elias Espino and at right is Xiang Wang, a U.C.S.D. Ph.D. student.

The testing will be done at UC San Diego's Jacobs School of Engineering's facility in Scripps Ranch. The 1.4 million-pound building has been placed on top of the country's biggest shake table, which is capable of simulating motions from nearly all past earthquakes, including the strongest ones.

U.C.S.D. Ph.D. student Xiang Wang, left, and S.D.S.U graduate student Elias Espino, at right, wait for the elevator on the second floor of the 5 story building that's to be used in an earthquake test. The room is set up as a home.

"What we are doing is the equivalent of giving this whole building an EKG to see how it performs after an earthquake and a fire," said Tara Hutchinson, the UC San Diego engineer who is leading the $5 million project.

The project was funded by the National Science Foundation, government agencies and by about 40 industry partners, which contributed equipment and materials that will help make for more realistic tests.

U.C.S.D.'s Engelkirk Structural Engineering Site on Pomerado Road, just east on Interstate 15 - View looking northeast of the 5 story building to be used in the earthquake test.

This week's test will simulate the magnitude 6.7 quake that hit Northridge in 1994, killing about 60 people and causing $20 billion in damage. Future tests will replicate the 8.8 quake that struck Chile in 2010. There have been only a handful of quakes in recorded history bigger than the Chile event, which killed more than 500 people. The quake also generated a tsunami that sent waves all the way to San Diego.

Scientists are especially interested in learning about how a large quake could affect hospitals, and the sort of computer centers used by emergency personnel. The vulnerability of medical centers was graphically exposed in 1971 during the 6.6 Sylmar earthquake, which left much of the Veterans Affairs Hospital in San Fernando in ruins and killed almost 50 people. The Olive View Hospital, which had opened only months earlier, partially collapsed.

The testing also will focus on refining scientists' basic understanding on ground motion. The shake table will simulate the 7.9 quake that hit Denali, Alaska, in 2002, largely because that shaking resembles the sort of ground motion that can happen in Southern and Central California.

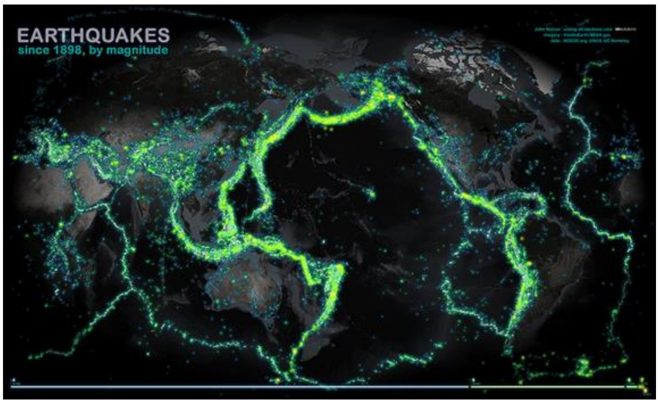
U.C.S.D.'s Engelkirk Structural Engineering Site on Pomerado Road, just east on Interstate 15 - Close view of the 5 story building to be used in the earthquake test.

For the initial tests, the building was raised four inches so it could be placed on top of four shock absorbers that focus energy at the base of a building to limit damage in higher stories. Even with the absorbers, the top of the building will twist and shake.

Later, the building will be jacked up so that the shock absorbers can be removed. The building will then sit flat on the shake table, which is how most buildings are situated.

(Gary Robbins / San Diego Union-Tribune, April 16, 2012, http://www.utsandiego.com/news/2012/apr/16/tp-engineers-earthquake-simulation-ready-to-roll)

100 Years of Earthquakes On One Gorgeous Map

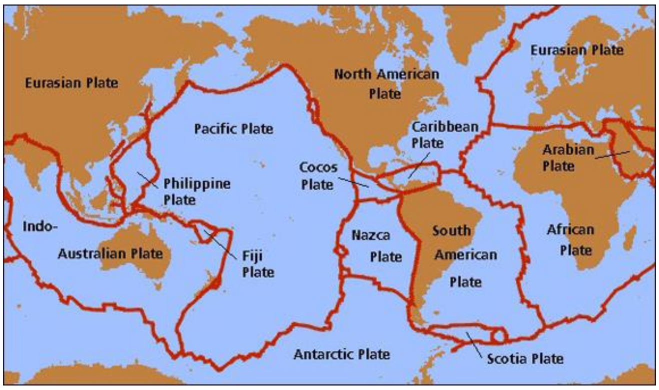


Every recorded earthquake of magnitude 4 of higher since 1898.

Data visualizer John Nelson, working for IDV Solutions, compiled historical earthquake records to produce this gorgeous, and informative, map. The larger, original version can be found here. Nelson chose to make the dots, which each represent an earthquake with a magnitude of 4 or higher, brighter or dimmer depending on the size of the quake, reports OurAmazingPlanet.

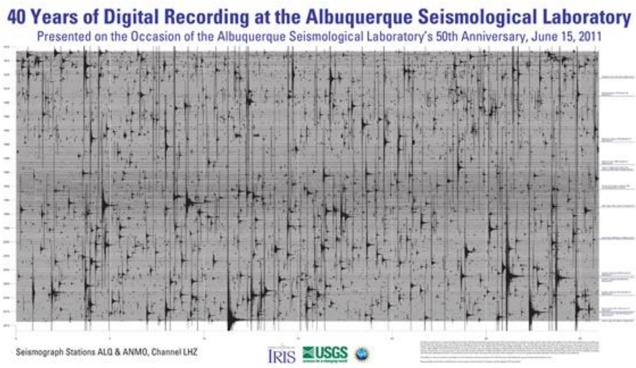
In all, 203,186 earthquakes are marked on the map, which is current through 2003. And it reveals the story of plate tectonics itself.

To be sure, the brightest and densest regions of the map provide a tragically beautiful view of the planet's tectonic plates. Though it may be even more interesting to see just how many earthquakes happen that aren't along these major lines, which are so-called intraplate earthquakes.



Earth's tectonic plates.

A slightly more technical take on a similar image appears in this IRIS image, which shows four decades of continuous earthquake detections from seismometers in Albuquerque, New Mexico.



(Colin Schultz / SMITHSONIAN.COM, July 2, 2012, http://blogs.smithsonianmag.com/smartnews/2012/07/100-years-of-earthquakes-on-one-gorgeous-map/?onsite_source=relatedarticles&onsite_medium=internal-link&onsite_campaign=SmithMag&onsite_content=100%20Years%20of%20Earthquakes%20On%20One%20Gorgeous%20Map)

California Institute of Technology tests early-warning earthquake system

A California Institute of Technology (CalTech) earthquake warning system was triggered by Tuesday night's Yorba Linda earthquakes. What if you could get the same alert in your own home?

CalTech ran the first real demonstration of its earthquake early-warning system at in Pasadena Wednesday.

"You can get notice that an earthquake has occurred and is about to shake your location before you actually feel the shaking," said Doug Given, U.S. Geological Survey.

The early-warning system sounds an audible alert, shows a countdown timer and estimates the intensity of an earthquake.

Seismologists say that once the technology advances, they should be able to faster determine a quake's magnitude and send that information out to the public before the strongest shaking waves reach your location.

"In the case of the first event last night, here in Pasadena we got about 9 seconds' warning before the strongest shaking was felt here. In the case of the second quake it was a little bit less, about 4 seconds' warning," said Given.

A few seconds may not sound like much, but the farther away you are from the epicenter, seismologists say, the more advanced warning you'll get.

So at a time when every second counts, why isn't the early-warning technology publicly available in California?

"It's also rather fragile at this point because it's built on the older technologies and with the very limited funding that the USGS currently has," said Given.

(Leslie Miller / EYE WITNESS NEWS - abc, August 08, 2012, http://abc7.com/archive/8767253)

Earthquake Damage: Are Bad Maps to Blame?

A new study argues that earthquake-hazard maps didn't give engineers and seismologists a full picture of several recent quakes' dangers

The badly damaged Japanese town of Yamada on March 12, 2011, a day after a massive 9.0-magnitude quake and tsunami hit the Tohoku region

Everyone makes mistakes — and sometimes, those mistakes can be deadly. Flawed hazard maps may be partly blamed for the devastation that accompanied the devastating earthquakes that have struck Japan, Haiti and China in recent years, according to a new study published in the journal Tectonophysics.

Hazard maps are guides to estimate how bad the earthquake danger is in any given area, and seismologists and engineers use them to gauge earthquake risk. But the maps can be oversimplified, largely because the mapmakers don't have enough data about earthquake history in their areas of interest. As such, the study says, they often work off their own preconceptions — and the maps don't do too well when those assumptions are wrong.

"We're playing a complicated game against nature," study co-author and earth-and-planetary-sciences professor Seth Stein said. "It's a very high-stakes game."

The study looked at three of the biggest earthquakes in the past five years, and whether the damage had been accurately predicted by the hazard maps:

Japan

The Tohoku earthquake of 2011 released 150 times more energy than hazard maps predicted. The maps estimated that an earthquake in the area would probably reach 7.5 on the Richter scale and that the Tohoku area was a lower-risk region than other parts of Japan. That March, the 9.0-magnitude earthquake that ravaged the area left tens of thousands dead, obliterated buildings and led to a meltdown at the Fukushima nuclear power plant.

Haiti

In 2001, hazard maps predicted low ground motion in Haiti based on recent earthquake data for the region. Had the maps taken a longer-term view of earthquake history, they would have shown that over history Haitian earthquakes are generally more damaging, and the 7.1-magnitude earthquake that ravaged Port-au-Prince in 2010 might have been a little more manageable.

China

Mapmakers assessed the Longmenshan fault as low risk, but they may not have considered the gradual movement across the fault that would eventually build enough tectonic pressure to cause a 7.9-magnitude earthquake in Sichuan province. This mistake came from a lack of evidence for large earthquakes on the fault over the past thousand years, according to the study.

The researchers who conducted the Tectonophysics study propose two changes to current mapping approaches: communicating the uncertainties of each map to users and checking each map against a reference map. Perhaps most important, however, is the authors' recommendation that mapmakers approach their jobs with a "sense of humility and caution." Nature is full of exceptions and surprises, and even the best hazard maps can't stop the planet from breaking the rules sometimes.

(Tara Thean / Time.com/NewsFeed blog, September 3, 2012, http://newsfeed.time.com/2012/09/03/earthquake-damage-are-bad-maps-to-blame)

☙ ❧

How Do You Make a Building Invisible to an Earthquake?

An inventive mathematician has a new idea for protecting buildings from earthquake damage: hide them.

William Parnell, of the University of Manchester in England, suggests wrapping a building's base, or at least key components, in specialized rubber that diverts certain temblor shock waves, leaving the building virtually untouched by them.

Parnell's "elastodynamic cloak," which engineers have just started testing, builds on a familiar concept: Waves headed directly for an object can be diffracted or bent so they miss it entirely. In the best-known example, scientists make objects appear invisible by encasing them within substances that have been engineered to alter the trajectory of light. When light waves pass through the cloak, they are channeled like water flowing around a rock. To an observer downstream, it appears that the light moved along a straight line, as if the object was not there.

Earthquakes are generated when two sections of the earth's crust suddenly slip against each other along a fault line, releasing energy that ripples through the surrounding rock as seismic waves. Among the most destructive are Love waves (named after British mathematician A.E.H. Love), which move the ground side to side in a zigzagging fashion.

According to Parnell's mathematical model, it's possible to channel seismic waves around an object by placing it at the precise center of an underground rubber cloak. Parnell calculates that if rubber is "pre-stressed"—stretched in a specific manner—it can mimic the capabilities of light-cloaking materials.

To be sure, engineers already lay rubber shock absorbers under some buildings to protect against earthquakes. But Parnell's cloak should prevent the structure from feeling Love waves at all. And, additional calculations indicate the cloak could potentially lessen the impact of other types of seismic waves—such as P waves, which alternately compress and stretch rock as they move through the ground.

While it may not be practical to surround whole buildings with rubber rings, cloaks could be placed around pilings or important electrical components. "Earthquake damage is not necessarily just caused by buildings falling down, but also by fires caused by electrical problems," Parnell says.

The earthquake cloak will be put to the test by engineers Biswajit Banerjee and Emilio Calius at Industrial Research Limited in New Zealand. They plan to create a pre-stressed region around a hole in a circular slab of rubber-like silicon. Then they'll measure whether vibrations are diverted around the hole.

Even if successful, Calius says, it will be many years before engineers could conceivably construct a building-size cloak. Still, if stressed rubber proves its worth, it might lend itself to other applications, such as soundproofing buildings from outside street noise. "Beyond invisibility," says Calius, "cloaking technology has profound implications for everyday life."

(Zeeya Merali / Smithsonian magazine, September 2012, http://www.smithsonianmag.com/science-nature/How-Do-You-Make-a-Building-Invisible-to-an-Earthquake-165590226.html)

☙ ❧

April Sumatra quakes signal Indian ocean plate break-up

The sequence of huge earthquakes that struck off the coast of Sumatra in April may signal the creation of a new tectonic plate boundary.

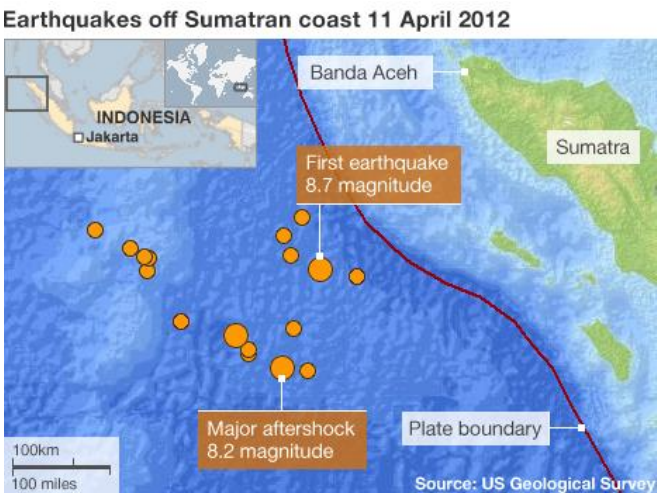
Scientists give the assessment in this week's Nature journal.

They say their analysis of the tremors - the biggest was a magnitude 8.7 - suggests major changes are taking place on the ocean floor that will eventually split the Indo-Australian plate in two.

It is not something that will happen soon; it could take millions of years.

"This is a process that probably started eight to 10 million years ago, so you can imagine how much longer it will take until we get a classic boundary," said Matthias Delescluse from the Ecole Normale Superieure in Paris.

Dr Delescluse is an author on one of three scholarly papers in Nature discussing the 11 April quakes.



Sumatra sits above the collision between the Indo-Australian plate and the Sunda plate.

These vast segments of the Earth's rigid outer shell are converging on each other at a rate of about 5-10cm/yr.

The elongated Indo-Australian, which comprises much of the Indian Ocean floor, dives under the Sunda, which carries the Indonesian island.

It is friction at their boundary - the sticking and unsticking, and the sudden release of stored energy - that is at the root of so many violent quakes, such as the magnitude 9.1 event on 26 December 2004 that set off a catastrophic tsunami.

But the 11 April 2012 tremors, although also immense in scale, did not have the same impact and generated no tsunami.

This can be explained by the nature of the faulting: so-called strike-slip, where rock moves horizontally either side of the line of breakage, as opposed to vertically in tsunamigenic thrust faults.

The April tremors were also much further west, located directly on the Indo-Australian plate itself in an area of large-scale deformation and multiple faulting.

Dr Delescluse said it was evident that movement at the plate's ends was stressing the middle.

"Australia already moves with respect to India, and India already moves with respect to Australia," he told the BBC World Service Science In Action Programme.

"They are separated by a lot of faults. And if you look on Earth today, between plates you have only one fault. So, the process we are talking about is how we go from several faults to only one fault.

"That's the question - we don't know how long it takes to weaken one so that it localises all the deformation and the others stop being active. At the moment, a lot of faults in the Indian Ocean are active."

All around the world

In a second Nature paper, Thorne Lay, of the University of California, Santa Cruz, and colleagues provide some fascinating detail on this interplay of faults and how they ruptured on 11 April. Their seismic analysis indicates at least four faults were involved in the main 8.7 event, which lasted about 160 seconds.

Three of the faults were parallel but offset from each other; the fourth was perpendicular to and crossed the first fault.

The 8.7 jolt "is probably the largest intraplate (within a single tectonic plate of Earth's crust) ever seismically recorded," Prof Lay's team remarked.

The third Nature paper describes how this historic quake triggered other tremors around the world.

This effect has been noted before, but Dr Fred Pollitz, from the US Geological Survey, and co-workers were surprised by the delays involved.

Dr Pollitz told the BBC: "For the vast majority of earthquakes, you can expect an aftershock zone not to really go beyond [1,000km].

"But it's also known that very large mainshocks - like the Japanese event we had last year, the magnitude 9 event off north-east Japan - can trigger earthquakes around the world. Most of these triggered events are small and they occur instantly as the seismic waves from the large event are passing by.

"But this April 2012 earthquake triggered many larger and potentially damaging earthquakes around the world, and with a time delay of hours or up to several days. That effectively extended the aftershock zone to the entire globe."

(Jonathan Amos / BBC News Science & Enviroment, 26 September 2012, http://www.bbc.co.uk/news/science-environment-19732681)

April 2012 intra-oceanic seismicity off Sumatra boosted by the Banda-Aceh megathrust

Matthias Delescluse, Nicolas Chamot-Rooke, Rodolphe Cattin, Luce Fleitout, Olga Trubienko & Christophe Vigny

Abstract

Large earthquakes nucleate at tectonic plate boundaries, and their occurrence within a plate's interior remains rare and poorly documented, especially offshore. The two large earthquakes that struck the northeastern Indian Ocean on 11 April 2012 are an exception: they are the largest strike-slip events reported in historical times and triggered large aftershocks worldwide. Yet they occurred within an intra-oceanic setting along the fossil fabric of the extinct Wharton basin, rather than on a discrete plate boundary. Here we show that the 11 April 2012 twin earthquakes are part of a continuing boost of the intraplate deformation between India and Australia that followed the Aceh 2004 and Nias 2005 megathrust earthquakes, subsequent to a stress transfer process recognized at other subduction zones. Using Coulomb stress change calculations, we show that the coseismic slips of the Aceh and Nias earthquakes can promote oceanic left-lateral strike-slip earthquakes on pre-existing meridian-aligned fault planes. We further show that persistent viscous relaxation in the asthenospheric mantle several years after the Aceh megathrust explains the time lag between the 2004 megathrust and the 2012 intraplate events. On a short timescale, the 2012 events provide new evidence for the interplay between megathrusts at the subduction interface and intraplate deformation offshore. On a longer geological timescale, the Australian plate, driven by slab-pull forces at the Sunda trench, is detaching from the Indian plate, which is subjected to resisting forces at the Himalayan front.

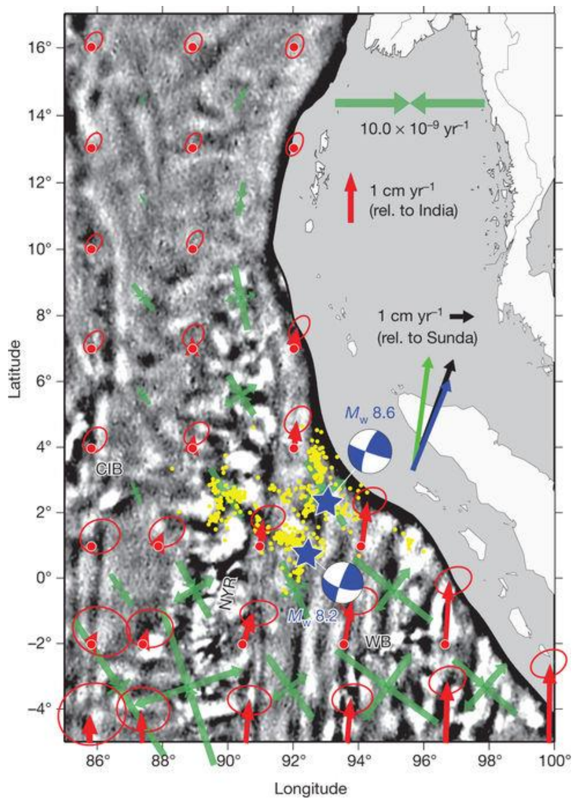


Figure 1: Present-day kinematics of the India–Australia plate.

The 11 April 2012 Mw 8.6 and Mw 8.2 earthquakes, shown here by their blue and white focal mechanisms ('beach-balls'), occurred in the Wharton basin (WB), at the heart of the diffuse plate boundary between India and Australia. Ninetyeast Ridge (NYR), which is the Kerguelen hotspot trail, separates the Wharton basin from the central Indian basin (CIB). Off trench, the background is the 120 km high-pass-filtered satellite free-air gravity anomaly, illuminating meridian aligned fracture zones. Three convergence vectors are displayed east of the Sumatra-Andaman trench, calculated at the location of the 2004 Aceh epicentre. The blue vector is India/Sunda vector (IN/SU) predicted by the MORVEL33 global model (46 mmyr^{-1} towards N22°E), while the green vector is the Australia/Sunda prediction using the same model (54 mmyr^{-1} towards N8°E). The true convergence vector is in between, since the subducting plate is neither India nor Australia. The black vector (56 mmyr^{-1} towards N20°E) is an estimation of the convergence rate that takes into account a non-rigid India-Australia plate. This non-rigid crustal velocity field is shown as red vectors with their 95% error ellipses at knot points west of the trench line. The corresponding strain-rate field is shown as green double arrows. At the latitude of the April 2012 earthquake sequence, motion of the Wharton basin with respect to India progressively increases west to east, from negligible close to Ninetyeast ridge to 10 mmyr^{-1} close to the trench.

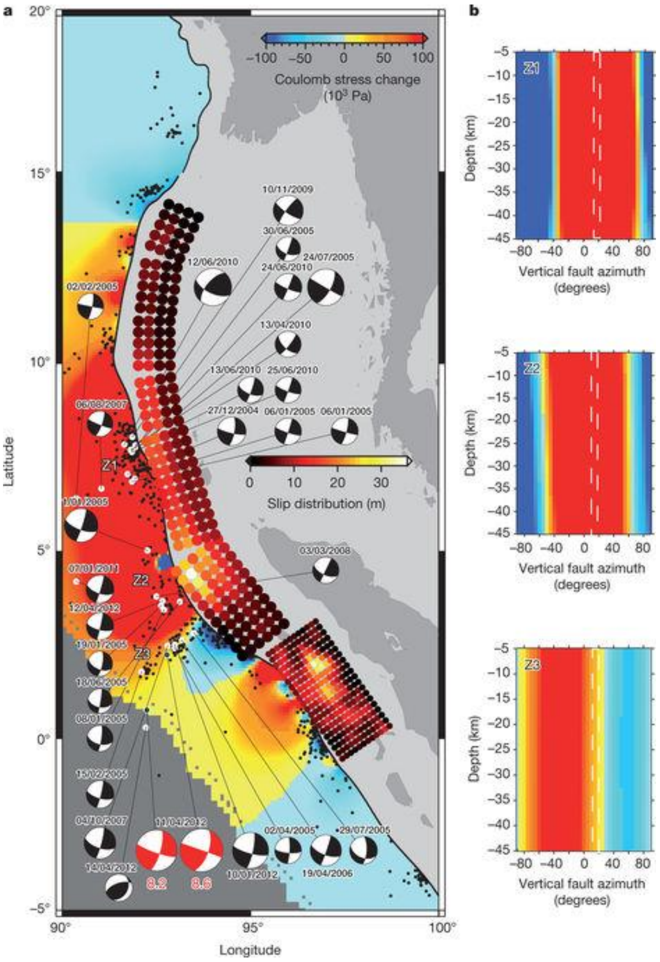


Figure 3: Static Coulomb stress change calculation offshore the Sumatra-Andaman subduction.

a, Each colour pixel represents a N15°E-oriented vertical fault plane. Note that the slip colour scale is adapted to the Aceh earthquake slip distribution, and requires division by a factor of three to obtain the Nias earthquake slip values. b, The Coulomb stress change has been tested for different depths and azimuths of the fault planes at three different locations, from north to south: Z1 (30 June 2005 earthquake location), Z2 (1 January 2005 earthquake location) and Z3 (11 April 2012 mainshock location). White bars bound the azimuths of the oceanic fabric. Slip on the oceanic fabric is best favoured to the north of the area.

Nature (2012), doi:10.1038/nature11520, 26 September 2012,
http://www.nature.com/nature/journal/vaop/ncurrent/full/nature11520.html#ref1

En échelon and orthogonal fault ruptures of the 11 April 2012 great intraplate earthquakes

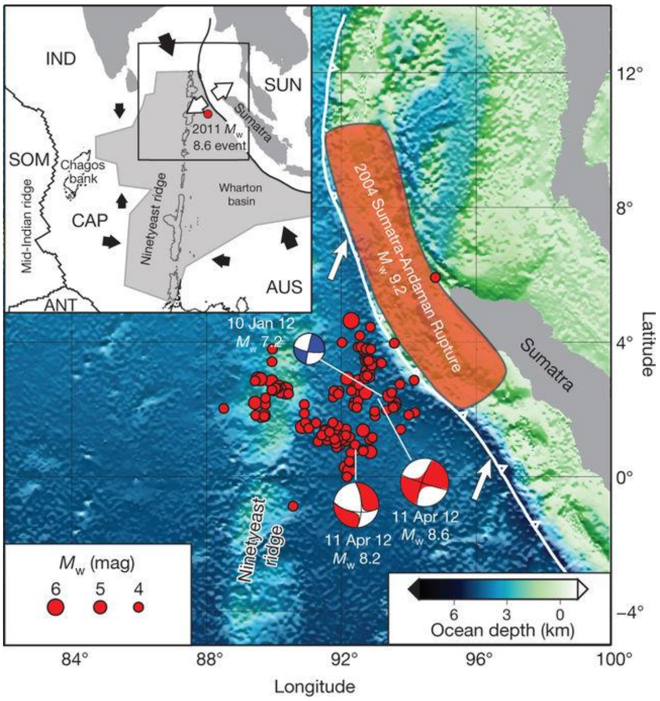
Han Yue, Thorne Lay & Keith D. Koper

Abstract

The Indo-Australian plate is undergoing distributed internal deformation caused by the lateral transition along its northern boundary—from an environment of continental collision to an island arc subduction zone1, 2. On 11 April 2012, one of the largest strike-slip earthquakes ever recorded (seismic moment magnitude Mw 8.7) occurred about 100–200 kilometres southwest of the Sumatra subduction zone. Occurrence of great intraplate strike-slip faulting located seaward of a subduction zone is unusual. It results from northwest–southeast compression within the plate caused by the India–Eurasia continental collision to the northwest, together with northeast–southwest extension associated with slab pull stresses as the plate underthrusts Sumatra to the northeast. Here we use seismic wave analyses to reveal that the 11 April 2012 event had an extraordinarily complex four-fault rupture lasting about 160 seconds, and was followed approximately two hours later by a great (Mw 8.2) aftershock. The mainshock rupture initially expanded bilaterally with large slip (20–30 metres) on a right-lateral strike-slip fault trending west-northwest to east-southeast (WNW–ESE), and then bilateral rupture was triggered on an orthogonal left-lateral strike-slip fault trending north-northeast to south-southwest (NNE–SSW) that crosses the first fault. This was followed by westward rupture on a second WNW–ESE strike-slip fault offset about 150 kilometres towards the southwest from the first fault. Finally, rupture was triggered on another en échelon WNW–ESE fault about 330 kilometres west of the epicentre crossing the Ninetyeast ridge. The great aftershock, with an epicentre located 185 kilometres to the SSW of the mainshock epicentre, ruptured bilaterally on a NNE–SSW fault. The complex faulting limits our resolution of the slip distribution. These great ruptures on a lattice of strike-slip faults that extend through the crust and a further 30–40 kilometres into the upper mantle represent large lithospheric deformation that may eventually lead to a localized boundary between the Indian and Australian plates.

Figure 1: The 11 April 2012 rupture sequence (next page).

Top inset, the regional plate tectonic setting, with the Indo-Australian plate being segmented into three subplates—India (IND), Australian (AUS) and Capricorn (CAP); also shown are the adjacent Somalian (SOM), Antarctic (ANT) and Sunda (SUN) plates. The light grey zone is a region of intraplate deformation between the subplates. Black arrows indicate directions of intraplate compression and white arrows show extension from subduction5. Major bathymetric features like the Chagos bank, Ninetyeast ridge and Wharton basin are indicated. Main panel, the USGS W-phase moment tensor solutions for the great events of 11 April 2012 (beachballs), USGS one-week aftershock locations (red circles with magnitude scale at lower left), and location and focal mechanism for the 10 January 2012 (Mw 7.2) event used as empirical Green functions in the surface wave analysis. The barbed line indicates the Sumatra trench, and the rupture zone of the Mw 9.2 Sumatra-Andaman underthrusting event15 is shown. Bathymetry is shown, with the colour scale at the lower right. White arrows indicate the direction of motion of the Indo-Australian composite plate relative to the Sunda plate.



Nature (2012), doi:10.1038/nature11492, 26 September 2012,
http://www.nature.com/nature/journal/vaop/ncurrent/full/nature11492.html

The 11 April 2012 east Indian Ocean earthquake triggered large aftershocks worldwide

Fred F. Pollitz, Ross S. Stein, Volkan Sevilgen & Roland Bürgmann

Abstract

Large earthquakes trigger very small earthquakes globally during passage of the seismic waves and during the following several hours to days1, 2, 3, 4, 5, 6, 7, 8, 9, 10, but so far remote aftershocks of moment magnitude M ≥ 5.5 have not been identified11, with the lone exception of an M = 6.9 quake remotely triggered by the surface waves from an M = 6.6 quake 4,800 kilometres away12. The 2012 east Indian Ocean earthquake that had a moment magnitude of 8.6 is the largest strike-slip event ever recorded. Here we show that the rate of occurrence of remote M ≥ 5.5 earthquakes (>1,500 kilometres from the epicentre) increased nearly fivefold for six days after the 2012 event, and extended in magnitude to M ≤ 7. These global aftershocks were located along the four lobes of Love-wave radiation; all struck where the dynamic shear strain is calculated to exceed 10−7 for at least 100 seconds during dynamic-wave passage. The other M ≥ 8.5 mainshocks during the past decade are thrusts; after these events, the global rate of occurrence of remote M ≥ 5.5 events increased by about one-third the rate following the 2012 shock and lasted for only two days, a weaker but possibly real increase. We suggest that the unprecedented delayed triggering power of the 2012 earthquake may have arisen because of its strike-slip source geometry or because the event struck at a time of an unusually low global earthquake rate, perhaps increasing the number of nucleation sites that were very close to failure.

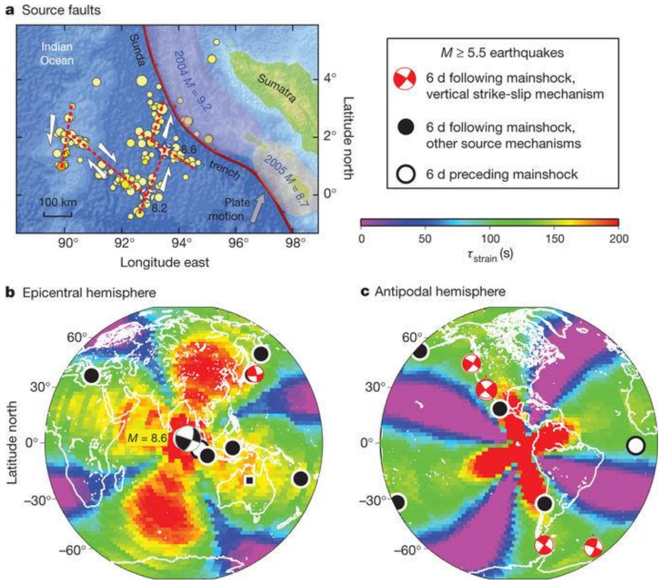


Figure 1: The 2012 M = 8.6 mainshock and M = 8.2 aftershock fault ruptures and maps of strain duration vs strain at a threshold value of 0.1 microstrain.

a, Inferred fault ruptures of the 11 April 2012 M = 8.6 east Indian Ocean earthquake and an M = 8.2 aftershock that occurred 2 h later. Superimposed are the first 20 d of M ≥ 4.5 aftershocks of 0–100 km depth. These earthquakes probably ruptured a complex set of subparallel and conjugate faults with the indicated sense of motion14, 15, 16, 17, 18, 19 (arrows). Parts of the rupture areas of the 2004 M = 9.2 and 2005 M = 8.7 Nias earthquakes on the Sunda megathrust are indicated. b, c, Global maps of vs strain (colour scale). Superimposed are the epicentres of M ≥ 5.5 events that occurred during the 6 d preceding the mainshock (2 epicentres) and following the mainshock (24 epicentres, 16 of which are remote, that is, >1,500 km from the mainshock). Focal mechanisms of six post-mainshock events with near-vertical strike-slip mechanisms (plunge of neutral axis, >60°) are indicated with red beachballs. The 9:00:09 11 April 2012 M = 5.5 event (in the western Aleutian Islands) occurred 21 min 33 s after the mainshock between the direct P- and S-wave arrivals from the mainshock; all others are delayed by hours to days. The focal mechanism of the mainshock is plotted at its epicentre.

(Nature (2012), doi:10.1038/nature11504, 26 September 2012,
http://www.nature.com/nature/journal/vaop/ncurrent/full/nature11504.html)

☙ ❧

Earthquake engineering: damage avoidance design

It was said that the financial cost of 2011's earthquake in Japan - and resulting tsunami and fires - could be as much as US$100 billion. After the devastating loss of life suffered, this is a huge economic cost to a nation.

Whilst the focus and priority must always be to reduce loss of life (through design codes) more can be done to reduce *the economic impact. Damian Grant, Senior Earthquake Engineer at Arup explains how engineers can make a difference by looking beyond code towards damage avoidance design.*

The traditional focus in the seismic design of buildings has been on ensuring life safety in a large earthquake. Significant damage is tolerated provided that the building does not collapse and evacuation of occupants is not impeded. As noted by by Kubilay Hicyilmaz[1], there are still many parts of the world where buildings have not been designed to be earthquake resistant, and death tolls are large in even moderate earthquakes. This is not just confined to the developing world – earlier this year, earthquakes in Northern Italy killed 25 people, and left 1000s without homes. In his piece, Kubilay urged engineers and architects to take a leadership role in ensuring that the next generation of houses built in earthquake prone regions of the world are designed to be earthquake resistant.

In parts of the world where seismic design codes are well developed and enforced – such as the United States, Japan and New Zealand – death tolls in earthquakes are generally low, and casualties are mostly a result of the collapse of older building stock that predates modern codes. The 2010 and 2011 earthquakes in Christchurch, New Zealand, claimed 185 victims – not insignificant for a city of only 370,000, but relatively low considering the extreme levels of ground shaking experienced. However, the economic and cultural heritage losses associated with the subsequent large-scale demolition of the Christchurch city centre have been immense, not to mention the disruption experienced in whole residential suburbs that have had to be abandoned due to the risk of further liquefaction or landslides.

The example of Christchurch, and other earthquakes over the last decades in the United States and Japan, is shifting the focus in seismic design of new buildings towards "damage avoidance design" (also referred to as "low damage design"). In this case, the goal is not merely to prevent sudden collapse and consequent human casualties, but also to allow the building to be re-occupied with minimal repair costs following a large earthquake.

Typically this is achieved by designing carefully engineered joints or devices that can accommodate-date the seismic movements imposed on the structure, rather than relying on yielding of steel or crushing of concrete. Seismic base isolation is the most mature and widespread of these technologies, and has been employed in the seismic protection of 1000s of buildings and bridges in Europe, the United States, Japan and New Zealand. Conceptually, seismic isolation works by separating the heavy mass of the structure from the vibration of the ground by a layer of flexible devices, so that when the ground moves, the isolators deform but the motion is not transmit-ted to the structure above. Isolation devices are laboratory tested before deployment, which gives confidence that their behaviour in the event of an earthquake will be as assumed in de-sign.

The photo below shows one of 300 seismic isolators being installed in the new international terminal at Sabiha Gökçen Airport, Istanbul – the world's "largest seismically isolated building"2.

Seismic isolation was also used recently on the large scale rebuilding project, the "C.A.S.E. Pro-ject"3, following the devastating L'Aquila earthquake in Italy in 2009. This involved the construction of 185 apartment buildings, sitting on a total of almost 7400 seismic isolators, comprising a total of 4600 apartments, all completed within 9 months of the earthquake. The key here was speed – especially when engineering and construction resources were stretched thin in the months following the disaster. Seismic isolation allowed confidence that these hastily constructed buildings will perform well in a future earthquake.

Sabiha Gökçen New International Airport, IstanbulIsolator-column-beam connection

A more recent application of damage avoidance design is to allow gaps to open up in the structure, thereby concentrating all the deformation imposed by the overall building movement in this gap rather than in large movements and damage in the structure. Of course, these gaps cannot be allowed to interfere with the structure's ability to support the weight of floors and roof, be-fore, during and after an earthquake. A mechanism that satisfies these objectives is to connect the components of the structure together with unbonded post-tensioning tendons, which act like giant rubber bands, both holding the structure together but also allowing rocking to occur at joints without slipping. These systems were first studied in detail as part of the PRESSS (Precast Seismic Structural Systems) research programme in California in the 1990s, and are now mature enough for implementation. In fact, the Southern Cross Endoscopy Building in Christchurch, built using such a system, escaped the 2010 and 2011 earthquakes relatively unscathed.

Until now, damage avoidance design has been mostly applied in buildings that serve an important role in post-earthquake recovery operations, such as hospitals or civil defence centres. However, in Christchurch, where the repair and rebuild costs associated with traditional design are now more widely appreciated by the general public, damage avoidance design is being employed even for conventional office or residential occupancies. The engineering community needs to be proactive – not reactive – in applying the best practical knowledge and technology in other seismic areas.

Kubilay is right that our first priority must be to implement any form of seismic resistant design in areas where existing building stock is substandard and large numbers of people are at risk. But it's important for us to realise that we can also make a huge difference in parts of the world with good seismic codes and construction practice, by looking beyond code – and beyond the next big earthquake – to a nearly undamaged built environment.

References

1 Kubilay Hicyilmaz "Engineering for earthquakes", the engineer, 3 November 2011, http://www.theengineer.co.uk/home/blog/engineering-for-earthquakes/1010803.article

2 Alexis Madrigal "Istanbul Opens World's Largest Earthquake-Safe Building", The New Yorker Reader, 20 November 2009, http://www.wired.com/wiredscience/2009/11/worlds-largest-earthquake-safe-building

3 The C.A.S.E. Project, http://www.protezionecivile.gov.it/resources/cms/documents/Bruxelles_progetto_CASE_en.pdf

4 Southern Cross Endoscopy Building, Christchurch, http://www.ccanz.org.nz/page/Southern-Cross-Endoscopy-Building-Christchurch.aspx

(Peter Young / theengineer, 7 January 2013, http://www.theengineer.co.uk/1015095.article?cmpid=TE01 http://www.theengineer.co.uk/home/blog/guest-blog/earthquake-engineering-damage-avoidance-design/1015095.article#ixzz2HP57YCAa)

Fibreglass fabric could protect old buildings from earthquakes

Researchers in Germany have developed a fibreglass fabric that can be attached to old buildings to try to protect them from earthquakes.

The seismic fabric developed at the Karlsruhe Institute of Technology (KIT) is designed to strengthen walls to prevent cracks from forming in them during an earthquake but can also pre-vent them from collapsing even if damage does occur.

'Thanks to the reinforcement, collapsing of walls due to earthquakes can be delayed and, in the ideal case, be avoided completely,' said the material's co-designer Moritz Urban in a statement.

'Particularly in the case of short and moderate earthquakes, mostly not much more additional tensile strength is needed to avoid a collapse of the building.'

The simple design of the fabric, which can be retrofitted using appropriate plaster, means it can be easily added to a wide range of buildings together with insulation, said Urban's research partner, Lothar Stempniewski.

'In the case of a catastrophe, much can be achieved if only we succeed in reinforcing and protecting critical infrastructures such as hospitals, schools, or rest homes,' he said.

According to KIT, the high stiffness and tensile strength of the glass fibres, which run in four directions, reduces the higher tensile stresses that occur in walls during earthquakes, helping to avoid damage that can develop into cracks.

If the glass fibres rupture during a heavy earthquake, the elastic polypropylene fibres in the fabric can reportedly hold the broken wall segments together, which could help give people in-side the building more time to escape.

The researchers worked with Dr Günther Kast GmbH & Co, a manufacturer of technical tissues, to commercialise the product. It is now being sold under the brand name Sisma Calce by Italian building material manufacturer Röfix.

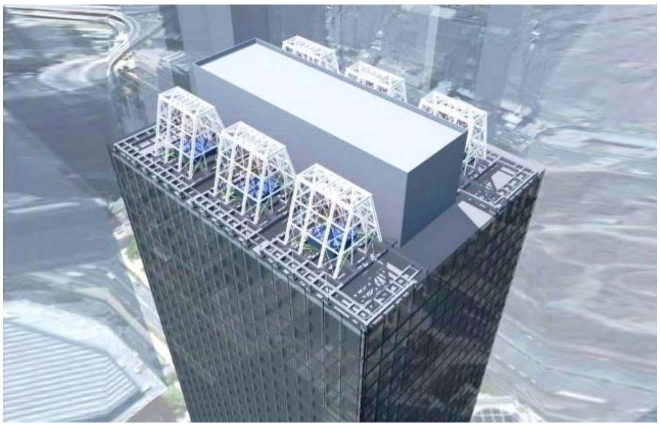
Stempniewski now intends to investigate similar solutions for concrete buildings.

'The challenge in the case of concrete is the higher force that must be absorbed,' he said. 'We thus test new materials such as carbon fibres. In doing so, we at the same time lay the foundations for future innovations to be developed by KIT.'

(theengineer / 8 January 2013, http://www.theengineer.co.uk/sectors/civil-and-structural/news/fibreglass-fabric-could-protect-old-buildings-from-earthquakes/1015110.article)

Giant rooftop pendulums to cut quake shaking in Tokyo

The Big One is due in Tokyo, but 300-ton pendulums on rooftops of tall buildings could cut shaking by 60 percent.



Swingers: Can 300-ton rooftop pendulums, colored blue in this illustration of the Shinjuku Mitsui Building, reduce sky-scraper shaking in quakes?

Tokyo seems overdue for a major quake. The last one was 90 years ago, when the Great Kanto Earthquake killed more than 100,000 people, and scientists say a big one may strike soon.

Buildings are better made today, yet over 6,000 people died in the Great Hanshin Earthquake that hit Kobe in 1995.

Now, two Japanese companies want to install giant pendulums on skyscraper rooftops to reduce the swaying caused by major earthquakes by 60 percent.

Real estate developer Mitsui Fudosan and construction firm Kajima said they have developed a 300-ton pendulum that will act as a counterweight to long-period seismic waves.

It's a variation of tuned mass damper technology, used in many towers, bridges, and buildings to reduce seismic vibration amplitudes.

The companies plan to spend about $51 million installing six such pendulums atop the Shinjuku Mitsui Building, a 55-story skyscraper in Tokyo completed in 1974.

The building swayed as much as 6 feet during the magnitude-9.0 quake that centered on northeast Japan in March 2011.

While the pendulums probably won't save lives, swaying can cause injury and damage to tall buildings.

Japan's first skyscraper was erected in 1968, and since then various vibration-dampening technologies have been used. Pendulum know-how has been used in newer high-rises, but the Mitsui-Kajima device could be retrofitted to older structures just by installing it on roofs.

It could also calm nerves. I was on the 20th floor of a Tokyo building in 2011 when seismic waves from a distant 7.0 quake hit, and the swaying wasn't something I'd like to experience again.

(Tim Hornyak / CNET, July 31, 2013, http://news.cnet.com/8301-17938_105-57596307-1/giant-rooftop-pendulums-to-cut-quake-shaking-in-tokyo)

Pendulum device to reduce swaying of skyscrapers during quakes

Two companies have developed a seismic control device weighing several hundred tons that can be installed on top of skyscrapers to suppress slow and large vibrations on the upper floors during major earthquakes.

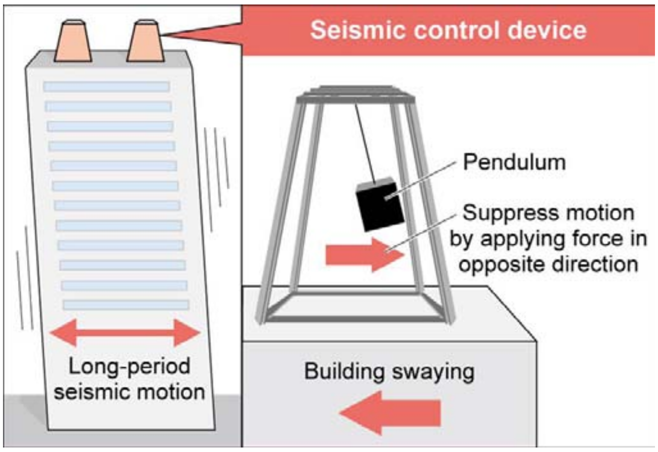
Real estate developer Mitsui Fudosan Co. and general contractor Kajima Corp. said July 29 that the device uses giant steel pendulums hung on the rooftop level that will apply force in the direction opposite of "long-period seismic motions," thereby more than halving the amplitude of vibrations.

The companies said they will spend about 5 billion yen ($51 million) to install the first device on top of Shinjuku Mitsui Building, a 55-story skyscraper in Tokyo, in 2015. The device will comprise six pendulums, each weighing 300 tons, to suppress swaying during earthquakes.

Shinjuku Mitsui Building experienced horizontal vibrations of about 2 meters during the magnitude-9.0 Great East Japan Earthquake on March 11, 2011. Such motions can damage building interiors and injure people inside.

The new device can not only reduce the vibrations by about 60 percent but could also shorten their duration during a potential earthquake of a similar scale, the companies said.

New high-rise buildings are often built with the pendulum technology. The device can be installed on the top of older skyscrapers without having to take up space inside.



(THE ASAHI SHIMBUN, July 30, 2013, http://ajw.asahi.com/article/economy/technology/AJ201307300084)

Tokyo Will Retrofit Its Skyscrapers to Prep for the Next Big Quake

Mass dampers — the gigantic weights designed to counteract swaying in skyscrapers — are usually installed during the construction process. But today, a Japanese real estate company announced plans to install six of the devices atop a 39-year-old building in downtown Tokyo. If all goes well, they could pop up on tall buildings all over the world.

The Shinjuku Mitsui Building is Tokyo's eighth tallest building, and one of its most recognisable, thanks to its 206m of stark black glass. It was completed in the mid-1970s, before tuned mass dampers were as common in tall buildings as they are today, but survived smaller earthquakes that have rattled the city since.

But according to CNET and The Japan Times, the building's developer, Mitsui Fudosan, is no longer content to let fate decide whether the building will weather the next storm. Working with the construction firm Kajima, Mitsui Fudosan is prototyping a mass damper that can be installed on pre-existing buildings. They've pledged ¥5 billion (or $US51 million) to install six pendulum-like devices — similar to traditional mass dampers — on the building's roof.

So what exactly do these contraptions do? For a good primer on tuned mass dampers, check out this infographic, but here's the basic gist: Mass dampers are gigantic pendulum-like counterweights that pull a building's mass in the opposite direction of the prevailing vibrations. So when the ground beneath a foundation moves laterally — either because of wind or seismic activity — the counterweight moves in the opposite direction, taking the structure with it. That's the essence of the dampers Mitsui Fudosan is planning for their tower, except in this case, the dampers are being installed after the fact. They'll add more than 300 tons to the building's weight, but could cut swaying by half, preventing structural damage that could bring a building down during a storm or quake.

Mass dampers have saved buildings from severe 'quake damage before. During the 2008 Sichuan Earthquake, the gigantic tuned mass damper inside of Taipei 101 — the city's tallest building — could be seen swaying to counteract the vibrations (see footage of it below). It's an incredible eerie effect, but it could save lives — and buildings. [Japan Times via CNET]

(Kelsey Campbell-Dollaghan / GIZMODO | Australia, 2 August 2013, http://www.gizmodo.com.au/2013/08/tokyo-will-retrofit-its-skyscrapers-to-prep-for-the-next-big-quake)

ΝΕΑ ΑΠΟ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

International Geosynthetics Society

Στο Τεύχος 1 του Τόμου 34 των IGS NEWS της International Geosynthetics Society, και συγκεκριμένα στο τμήμα Corporate Membership / Case Studies – Use the Chance, παρατίθεται το παρακάτω άρθρο του Ομίλου ΠΛΑΣΤΙΚΑ ΘΡΑΚΗΣ.

Thessaloniki Metropolitan Railway (Greece)

Objective

Thessaloniki Metro is considered as the most extensive transport project in Northern Greece underway and is expected to be completed in three construction phases. At the moment, Phase 1 and Phase 2 of the project are in progress. Phase 1 involves the construction of the base underground line. The Line consists of two independent single-track tunnels, which form a network with an overall length of 9.6km. Along its length, 13 modern center platform stations will serve the 18 fully automatic driverless metro trains which are expected to carry 18000 passengers per hour in each direction. The 7.7km section constructed by means of two Tunnel Boring Machines has already been completed. The remaining section of the base line will be constructed by applying the Cut and Cover method. Completion of Phase 1 is expected by the end of 2020.

Figure 1: View during construction

The Challenge

An integrated system consisting of HDPE geomembranes (1.5mm and 2.0mm thick) was qualified for waterproofing (i) the bottom and the lateral concrete walls of the stations and (ii) the shell of the tunnels. Needle-punched nonwoven geotextiles weighing 500gr/m2 and 800gr/m2 were specified as cushions for protecting the geomembranes. At the formation level (under the concrete floor of the stations), a 140gr/m2 needle-punched nonwoven geotextile was specified to separate the existing soil at the bottom of the excavation from the drainage layer consisting of a typical 30cm thick base course gravel. Over the aggregates, the installation of the waterproofing system and the construction of each station was planned to follow.

Figure 2: Geomembrane placement on top of the cushion geotextile

The Solution

Following the specifications of the design for cushioning materials, Thrace Nonwovens & Geosynthetics provided needle-punched nonwoven geotextiles weighing 500gr/m2 and 800gr/m2 namely P500NW and P800NW, respectively. The geotextiles were used to protect both sides of the geomembranes from damage due to contact with either the coarse particles of the drainage layer or the protrusions on the rough concrete/shotcrete surfaces. A 140gr/m2 needle-punched nonwoven geotextile, under the trade description S12NW, was provided to act as a separator. The specific geotextile had the appropriate hydraulic characteristics to serve efficiently as filter for the aggregate layer, as well.

Figure 3: Cushion geotextile installation

After works resumed in March of 2016, more than 150.000 sqm of THRACE NG nonwoven geotextiles have been installed all along the base underground line.

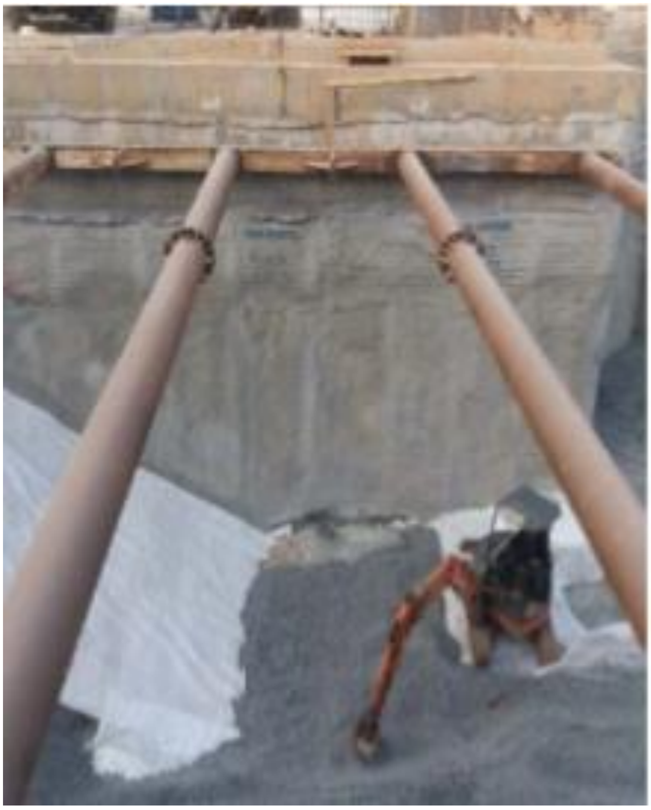


Figure 4: Spreading of the aggregates upon the geosynthetic separator

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

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

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Geotechnical Construction of Civil Engineering & Transport Structures of the Asian-Pacific Region

4 ÷ 7 July, 2018, Yuzhno-Sakhalinsk, Russia

http://gccets.com

Construction of infrastructure and transport facilities in rough geological conditions and protection against natural disasters are very challenging tasks demanding the cooperation of efforts of scientists, designers and contractors.

Complicated geotechnical problems are faced in the conditions of high probability of earthquakes, landslides, mudflows, snow avalanches, flooding and other hazardous phenomena such as break of dams, underground mountain row collapsing, large-scale and intensive oil and gas leakages, industrial and terrorist explosions and other techno/anthropogenic impacts.

The organizers of the International Geotechnical Symposium taking place in the city of Yuzhno-Sakhalinsk (Russia) on 04-07 of July, 2018, are the International Technical Committee 203 of Earthquake Geotechnical Engineering and Associated Problems (TC203); International Technical Committee № 216 ISSMGE Frozen soils; Technical Committee № 202 «Transportation geotechnics», The Asian Technical Committee №3 (ATC-3) of Geotechnology for Natural Hazards, The Commission on Earthquake Engineering and Mitigating Industrial & Natural Disasters (CoMIND), Centre on EQE&NDR, The Russian Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and Kazakhstan Geotechnical society.

The Symposium has attracted for participation the experts from the CIS countries (especially from Russia and Kazakhstan), Japan, the USA, Canada, Finland, Belgium, Holland, Poland, Australia and India.

The purpose of the symposium

The main attention is paid to sharing knowledge on reliable preventive geotechnical measures oriented to damage minimization when the available information is either incomplete or inconsistent.

The experts invited for participation in the Symposium will present special lectures, viva-voce and poster reports, exhibit the equipment and devices, introduce various achievements in geotechnical engineering and discuss the lessons learned from resent disasters and to share the modern knowledge & technologies implemented into practice for damage mitigation.

As a result, the papers are received dealing with the improved practical approaches and engineering solutions, unified new construction, codes and regulations to prevent and reduce the disasters before they strike again.

The symposium themes

Exploration Geophysics

Geophysical methods to measure the physical properties of the subsurface:

- for finding mineral or hydrocarbon deposits;
- for monitoring environmental impact;
- for ground water investigations;
- for civil engineering site investigations

Geomonitoring, modeling and prognosis of natural and emergency situations

- earthquakes, tsunamis, typhoons;
- landslides, mud flows, volcanic eruptions, floodings;
- soil liquefaction, scuffling, swelling, freezing of the soil bases

Geomaterials for construction and reconstruction

Geophysical methods to measure the physical properties of the subsurface. Geophysical methods to measure the physical properties of the subsurface.

Geotechnical measures for natural disaster reduction of

- marine engineering;
- railways and highways, pipelines;
- bridges, tunnels, aerodrome;
- civil engineering structures

Geotechnical engineering in special environments

- geotechnical engineering in cold climate regions;
- geotechnical engineering in high-mountainous regions;
- geotechnical engineering in zones of fluctuation of a sea level

Geoecology of extreme situations transportation objects

- geotechnics of embankments, waste and tailings storages;
- geotechnics of industrial, radioactive waste products;
- pollution of river and sea bottoms;
- geoecology of oil & gas deposits;
- the use of mineral resources to reduce the negative impact on the environment

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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, Perú 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 Conference on Geotechnical Engineering and Architecture

URBAN PLANNING BELOW THE GROUND LEVEL: ARCHITECTURE AND GEOTECHNICS

19-21 September 2018, Saint Petersburg, Russia

The Intended Subject Areas

- Underground Master-Planning in a Megacity, or "WHAT SHOULD GO UNDERGROUND?"
- Underground Development and Preservation of Historic City Sites, or "UNDERGROUND CONSTRUCTION AS MEANS OF PRESERVING HISTORIC CITIES"
- Architectural Features of Underground Cities, or "AN UNDERGROUND HOUSE"
- Geotechnologies in Development of Underground Space, or "HOW TO BUILD AN UNDERGROUND STRUCTURE?"
- Soil-Structure Interaction, or "HOW TO CALCULATE AN UNDERGROUND STRUCTURE?"
- Monitoring in Underground Construction, or "UNDERGROUND CONSTRUCTION: HOW TO MAKE IT SAFE?"

Main Objective of the Conference

An exchange of ideas between architects, restoration and preservation specialists, and geotechnical engineers on a range of subjects related to development of underground space in megacities. Recently a big number of conferences have been held involving specialists in one field. The purpose of this Conference is to further interdisciplinary exchange of professionals representing different fields.

The Conference is expected to enjoy participation of researchers and practitioners from Russia, the CIS, Europe, Asia, America and Australia.

We invite professionals in the fields of Architecture, Geotechnical Engineering, Engineering Geology and Underground Construction to take part in the Conference and present their papers.

Conference Administrators

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O.A. Pruss, +7 (812) 339-3587, 575-3587, Fax: 575-3625, mail@georec.spb.ru

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 2018, London, United Kingdom, www.ice.org.uk/events/global-engineering-congress

ISEV
2018
CHANGSHA

The 8th International Symposium on Environmental Vibration and Transportation Geodynamics & the 2nd Young Transportation Geotechnics Engineers Meeting

October 26–28, 2018, Changsha, China

www.isev2018.cn

The 8th International Symposium on Environmental Vibration and Transportation Geodynamics (formerly named as the International Symposium on Environmental Vibration) will be held on October 27-28, 2018 at Central South University, Changsha, China. In 2003, the first symposium was initiated by Prof. H. Takemiya of Okayama University, Japan and Prof. Yunmin Chen of Zhejiang University, China, and held in Zhejiang University, Hangzhou, China. The subsequent six symposia were successfully convened in Okayama University, Japan (2005), National Taiwan University, Taipei (2007), Beijing Jiaotong University, China (2009), Southwest Jiaotong University, China (2011), Tongji University, China (2013), and Zhejiang University, China (2016), respectively. With the increasing impact over academia and industry, the symposia have attracted much attention from government officials, scientific and research communities, and engineer-ing professionals. Geotechnical challenges associated with dynamic loads on railroad track and road pavements often require scientific and technological breakthroughs for design innovations. To effectively reflect such frontiers, this symposium has been renamed as International Symposium on Environmental Vibration and Transportation Geodynamics since 2016, and held under the auspices of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) TC202 Transportation Geotechnics Committee. The scope of the 8th International Symposium on Environmental Vibration and Transportation Geodynamics 2018 (ISEV 2018) will continue to cover environmental vibrations induced by industrial, civilian and transportation activities, problems associated with dynamic vehicular loading on road foundations, and sustainability challenges of transportation infrastructures and the built environment. The symposium will consist of workshops (including one dedicated to Young Transportation Geo-technics Engineers) and plenary and breakout sessions as well as a technical exhibition for dissemination of research findings and engineering best practices. Since it will serve as a significant platform for academic exploration, experience exchange, and thought inspiration amongst the practitioners engaged in management, design and construction of large-scale civil and transportation infrastructure, researchers, academics and students; engineers; planning, design construction and management engineering companies; decision makers; transport infra-structures managers; owners and governmental bodies are especially encouraged to attend this symposium.

Associated with the ISEV 2018 event, the 2nd Young Transportation Geotechnics Engineers (YTGE) meeting will be concurrently held on October 26, 2018. The 1st meeting of the YTGE associated with the 3rd International Confer-ence on Transportation Geotechnics (ICTG) was successfully convened at University of Minho, Guimarães, Portugal on September 4, 2016. This forum was organized and hosted by students at the University of Minho with student participation from all around the world. It covered all the disciplines in transportation geotechnics (roads, highways, bridges, airports, railways, waterways, canals and terminals- harbors). For the first time, it created a knowledge exchange network and compiled what the best and most advanced practices worldwide in the transportation geo-technics field are either in academic or in industrial domains. The YTGE network will also be created in the framework of the ISEV 2018 event and will be held in Changsha, China on October 26, 2018. The main goal of this forum will be to increase the attractiveness of the transportation geotechnics field for younger generations of geotechnical engineers (less than 35 years old), whilst contributing to strengthen the role of young engineers in society. The network will be responsible for organizing several initiatives for the young geotechnical community. The aims are to provide an international forum for doctoral and post-doctoral students as well as research engineers and engineers involved in innovation in transportation geotechnics, to present and discuss their main research results, and to identify future research and engineering practice needs. Relevant work related to all disciplines in transportation geotechnics are sought out for the 2nd YTGE meeting in the form of a two-page extended abstract and workshop presentation.

CONFERENCE THEMES

- Dynamic interaction of vehicle and transportation infrastructure (pavement, railway and airfield)
- Wave propagation and traffic induced structure and ground vibrations
- Environmental vibration issues in Metro
- Soil-structure dynamic interaction problem in transportation

- Analysis and testing on environmental vibration
- Vehicle, machine and human induced vibrations
- Monitoring, evaluation and control of traffic induced vibrations
- Cyclic deformation of soils and transportation foundation settlement
- Structural safety and serviceability of railway, metro, roadway and bridges
- Application of geosynthetics in transportation infrastructure
- Advances in materials characterization, laboratory and field evaluation, and full scale testing (ALF, HVS) and monitoring of roads, railways and airfields
- Stabilization/treatment of foundation geomaterials of roads, railways, and airfields.

Contact us

8th ISEV & 2nd YTGE Secretariat
E-mail: ISEV2018@yahoo.com
Tel.:(+86) 731-8265-5177
Central South University, School of Civil Engineering. 22 South Shaoshan Road Changsha, Hunan. 410075 China

8th International Congress on Environmental Geotechnics
"Towards a Sustainable Geoenvironment"
28 October to 01 November 2018, Hangzhou, China
www.iceg2018.org

Issues associated with Environmental Geotechnics continue to be a major preoccupation for governments, public and private organizations and the general community around the world. With the support from the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and the Technical Committee of Environmental Geotechnics (TC215), the Environmental Geotechnics Congress Series has been held regularly since 1994 (Canada 1994; Japan 1996; Portugal, 1998; Brazil 2002; UK 2006; India 2010; Australia 2014), and has established itself as a highly influential forum for exchange and discussion on the subject.

The Ministry of Education Key Laboratory of Soft Soils and Geoenvironmental Engineering, Zhejiang University, CISMGE and HKGES cordially invite you to attend the 8th International Congress on Environmental Geotechnics in the week of October 28th, 2018 in Hangzhou, China.

Theme & Topics

The congress theme is "Towards a Sustainable Geoenvironment." "Sustainable Development is to meet the needs of the present without compromising the ability of future generations to meet their own needs." Geoenvironment is a specific compartment of the environment and comprises portions of geosphere, hydrosphere and biosphere. Under this theme the congress will cover a broad range of topics and will provide an excellent opportunity for academics, engineers, scientists, government officials, regulators and planners to present, discuss and exchange the latest advancements and developments in the research and application of environmental geotechnics.

The following topics are tentatively proposed:

Geoenvironmental risk assessment, management and sustainability
- Sustainability
- Risk-based site evaluation and management
- Case histories and regional experiences

Geotechnical recycling and reuse of waste materials
- Construction and demolition wastes
- Coal combustion residues
- Dredged sediments
- Other solid wastes

Transport, persistence and fate of pollutants
- Advection
- Diffusion
- Adsorption
- Degradation and attenuation
- Emerging contaminants

Contaminated land and remediation technology
- Site investigation
- In-situ remediation
- Off site remediation
- New remediation technologies

Engineering barriers
- Covers
- Liners
- Vertical barriers

Landfills of solid wastes
- Waste characterization and properties
- Stability
- Deformation
- Greenhouse gas and odor reduction

Application of geosynthetics in geo-environmental engineering
- Geotextiles and geocomposites
- Geomembranes
- Geosynthetic clay liners
- Other geosynthetics

Geoenvironmental aspect in energy geotechnology
- Nuclear waste
- CO_2 sequestration
- Shallow and deep geothermal
- Methane hydrates
- Underground storage facilities

Tailings and mine wastes
- Tailing ponds
- Waste dumps
- Acid mine drainage
- Heap leach pads

Biogeotechnical engineering

- Biomediation
- Bioremediation
- Phytostabilization and phytoremediation

Forensic environmental geotechnics

- Failure case studies

Organizing Committee of the 8th International Congress on Environmental Geotechnics

Ministry of Education Key Laboratory of Soft Soils and Geoenvironmental Engineering, Zhejiang University, Hangzhou, Zhejiang Province, China, P.R. 310058

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

UNSAT Oran 2018
4ème Colloque International Sols Non Saturés & Construction Durable
30-31 October 2018, Oran, Algeria
www.unsat-dz.org

Présentation du groupe unsat-dz

Unsat-dz est un réseau constitué d'équipes de recherche algériennes qui travaillent dans le domaine des sols non saturés. Il a été créé le 27 Octobre 2009, lors d'une réunion tenue en marge du Colloque International Sols Non Saturés et Environnement qui a eu lieu à Tlemcen les 27 et 28 Octobre 2009, en collaboration avec l'université du Havre. Cette réunion avait rassemblé des représentants de différentes universités nationales. Des chercheurs internationaux avaient aussi pris part à cette réunion pour faire bénéficier de leurs expériences respectives dans les groupes de recherche européens (Membres présents à la réunion de création du réseau unsat-dz).

Unsat-dz n'est pas une association qui sera agréée à un niveau régional ou national. C'est un **cadre ouvert à toutes les équipes de recherche** nationales, et méditerranéennes, qui veulent contribuer à travers ce groupe au développement de la recherche scientifique dans le domaine des sols non saturés.

Objectifs

L'objectif principal de ce groupe est de fédérer les moyens humains et matériels, en vue d'une collaboration plus active et plus organisée entre les équipes de recherche de différents établissements sur cette thématique (sujets de recherche communs, thèses co-encadrées, réponses à des appels à projets nationaux et internationaux, etc.). Le réseau va oeuvrer à travers des actions de court, moyen et long termes.

Les actions de court terme définies lors de la réunion du 27 Octobre sont :

1- **Recensement des équipes de recherche** algériennes dans le domaine du non saturé,

2- **Création d'un site internet** qui sera un espace qui présentera les différentes équipes de recherche, ce sera aussi un espace de réflexion et d'échange entre ces équipes.

Le suivi de ces deux actions est actuellment assuré par l'équipe de l'université de Tlemcen. A la fin du premier trimestre 2010, un premier bilan sera établi et les actions futures seront définies.

Comment adhérer au réseau unsat-dz?

Si vous faites partie **d'une équipe** qui a des axes de recherche en relation avec les sols non saturés et si vous souhaitez adhérer au groupe unsat-dz, nous vous invitons à renseigner le formulaire ci-joint et nous le renvoyer signé par le responsable de l'équipe (01 seul formulaire par équipe).

Le signataire du formulaire (Directeur de laboratoire ou chef d'équipe) garantit l'authenticité des informations fournies.

Le revoir du formulaire renseigné et signé signifie implicitement:

- **Une demande d'adhésion** de l'équipe au groupe unsat-dz.
- **Un engagement de l'équipe** à œuvrer pour le développement et la concrétisation des objectifs de unsat-dz.
- **Une autorisation de communication des informations** fournies concernant l'équipe et notamment à travers le site unsat-dz.org

Par ailleurs, les équipes de recherche auront **un droit de regard**, de modification et d'actualisation des informations les concernant. Elles se réservent aussi le droit de se retirer de unsat-dz.

Secrétariat de UNSAT-DZ
Laboratoire Eau et Ouvrages dans Leur Environnement (EOLE), Faculté de Technologie,
Université Aboubakr BELKAID - BP 230, Chetouane, Tlemcen.
Tél : (+213) (0) 666 79 79 40 - Fax (+213) (0) 43 28 56 85 - e-mail : contact@unsat-dz.org

Energy and Geotechnics
The First Vietnam Symposium on Advances in Offshore Engineering
1-3 November 2018, Hanoi, Vietnam
https://vsoe2018.sciencesconf.org

The Vietnam Symposium on Advances in Offshore Engineering (VSOE) is organised every two years by the Association of Vietnamese Scientists and Experts (AVSE Global) in collaboration with universities and research bodies in Vietnam.

VSOE is aimed to create platform for researchers, practitioners, policymakers, and entrepreneur to discuss and promote technology and policy changes toward renewable energy, as well as generate business opportunities in oil and gas and offshore renewable energy. VSOE is also designed to support Vietnamese and Asia-Pacific oil and gas sectors to adjust their business model and strategy to deal with the new trends and challenges.

The first symposium, VSOE2018, will be hosted by National University of Civil Engineering, Hanoi, devoting to the topic of "**Energy and Geotechnics**". VSOE2018 seeks to bring together knowledge and experience gained recently in offshore engineering and technology innovations, cost-effective and safer foundation and structural solutions, environment protection, hazards, vulnerability, and risk management.

SYMPOSIUM TOPICS

Fossil energy: Technology, Opportunities and Challenges

Offshore renewable energy assessment and forecast

Wind, wave, tidal and current turbine systems

Site Characterisation and Ground Modelling

- In situ characterisation
- Laboratory testing
- Geology and geo-hazards
- Submarine slope stability
- Environmental considerations
- Gas hydrates

Design of offshore foundations and structures

- Shallow foundations
- Gravity-based structure (GBS)
- Pile foundations and monopiles
- Anchors for floating structures (including suction, pile, drag/gravity-embedment anchors)
- Caisson foundations
- Spudcans for jack-up rigs
- Pipeline/rise-soil interaction
- Well and conductor geotechnics
- Offshore structures

Geotechnical Performance of offshore structures

- Model tests
- Field tests
- Field monitoring
- Back-calculations
- Case histories

Remediation of offshore structures and foundations

Decommissioning of offshore geotechnical structures

Design standards, risk and reliability

Contact vsoe2018@sciencesconf.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

Second JTC1 Workshop on Triggering and Propagation of Rapid Flow-Like Landslides
03-05 December 2018, Hong Kong

Organiser: Joint Technical Committee on Natural Slopes and Landslides (JTC1)

Co-organiser: The Hong Kong Geotechnical Society; The Geotechnical Division of the Hong Kong Institution of Engineers; The Hong Kong University of Science and Technology

Contact person:

Professor Clarence Choi
Hong Kong University of Science and Technology, Clear Way Bay, Kowloon
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13th Australia New Zealand Conference on Geomechanics 2019
01 ÷ 03-04-2019, Perth, Australia
http://geomechanics2019.com.au

On behalf of the Australian Geomechanics Society, the New Zealand Geotechnical Society and the Conference Organising Committee it is my pleasure to invite you to the **13th Australia New Zealand Conference on Geomechanics in 2019** in Perth, Western Australia.

The conference will be held at the Perth Convention and Exhibition Centre situated in the heart of Perth in Western Australia. The conference has a diverse range of themes including: Foundations and Retaining Structure, Ground Improvement, Offshore and Nearshore Geotechnics plus many more.

This promises to be an ideal forum for exploring the recent learnings in the broader Geomechanics community. It is from these learnings that the industry is able to continue to drive new innovations and drive practice forward.

The Australia New Zealand Conference on Geomechanics is always an important meeting place for professionals working in the Geomechanics industry and will again be a great place to explore the new directions emerging in the industry. It is an opportunity to engage with speakers from across Australia, meet up with colleagues, network and visit the exhibitor displays.

Conference Managers

Arinex Pty Ltd
ABN.28 000 386 676
3/110 Mounts Bay Road
Perth, Western Australia 6000
Tel: 08 9486 2000
Fax: 08 9267 5443
ANZgeomechanics2019@arinex.com.au

☙ ❧

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

Underground Construction Prague 2019, June 3–5, 2019, Prague, Czech Republic, www.ucprague.com

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

ICONHIC2019 - 2nd International Conference on Natural Hazards and Infrastructure, 23-26 June 2019, Chania, Crete Island, Greece, https://iconhic.com/2019/conference

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

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

14th Baltic Sea Geotechnical Conference 2020
25 ÷ 27 May 2020, Helsinki, Finland

Organiser: Finnish Geotechnical Society
Contact person: Leena Korkiala-Tanttu
Email: leena.korkiala-tanttu@aalto.fi
Website: http://www.ril.fi/en/events/bsgc-2020.html
Email: ville.raassakka@ril.fi

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

Contact person: Prof. Leena Korkiala-Tanttu
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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

Geotechnical Aspects of Underground Construction In Soft Ground
29 June to 01 July 2020, Cambridge, United Kingdom

Organiser: University of Cambridge
Contact person: Dr Mohammed Elshafie
Address: Laing O'Rourke Centre, Department of Engineering, Cambridge University
Phone: +44(0) 1223 332780
Email: me254@cam.ac.uk

www.eurogeo7.org

We are pleased to invite you to the 7th EuroGeo conference, to be held in Warsaw, Poland in 2020. Poland is a country with more than a thousand years of recorded history and has a strong European identity. The country was first to free itself from communist domination in 1989 and is now fully democratic and a member of the European Union. Poland is a leader in infrastructure development in the region, which has resulted in many extraordinary projects. Warsaw, with its central location, is an ideal base for exploring the country. Today, the city is a dynamic cultural and business centre, with strong links not only to Western Europe but also to the East. PSG-IGS, a Polish Chapter of IGS is young but thriving organization successfully cooperating with several chapters within Central Europe. It is an honour to host such a prestigious conference in Warsaw and We sincerely believe that the sessions will prove to be a success. Come to Warsaw, bring your family and enjoy your stay in our capital and help us to make this Conference not only scientifically profitable but also an unforgettable event.

Contact: eurogeo7inpoland@gmail.com

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
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Website: http://www.isc6-budapest.com
Email: info@isc6-budapest.com

Implementation and Monitoring the USDR-ICL Sendai Partnerships 2015-2025
2-6 November 2020, Kyoto, Japan
http://wlf5.iplhq.org

The ISDR-ICL Sendai Partnerships 2015-2025 for Global Promotion of Understanding and Reducing Landslide Disaster Risk was adopted on 16 March 2015 as a voluntary commitment to the United Nations World Conference on Disaster Risk Reduction, held in Sendai, Japan, 14-18 March 2015.

It is a supporting tool for the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 which was adopted at the afore-mentioned Conference. Seventeen global stakeholders have adhered to, and signed the Partnerships.

The Fifth World Landslide Forum will be organized in Japan to achieve a mid-term review, and assess the progress made in the implementation of the Partnerships and to mobilize further commitment and actions to advance the implementation over the following five years.

The International Consortium on Landslides (ICL) and the ISDR-ICL Sendai Partnerships 2015-2025 invite you to join the 5th World Landslide Forum (WLF5) to be held November 2-6, 2020, in Kyoto Japan. This Forum will include a mid-term review of the ISDR-ICL Sendai Partnerships, voluntary contribution to the Sendai Framework 2015-2030 and the Agenda 2030 – Sustainable Development Goals, especially Goal 11 *Make cities and human settlements inclusive, safe, resilient and sustainable.* Participants of the Fourth World Landslide Forum adopted the 2017 Ljubljana Declarationon Landslide Risk Reduction – contributing to the Sendai Framework for Disaster Risk Reduction. The Declaration proposes the Kyoto 2020 Commitment for Global Promotion of Understanding and Reducing Landslide Disaster Risk to be finalized during the preparatory activities for WLF5 and adopted during WLF5 in order to serve this purpose. The Commitment aims to establish in the medium and long term a global alliance that will accelerate and incentivize action for landslide risk reduction.

Themes of WLF5

Theme 1: Sendai Partnerships 2015-2025 and Kyoto 2020 Commitment

Theme 2: Hazard and vulnerability mapping and zonation

Theme 3: Monitoring and early warning

Theme 4: Testing, modeling and risk assessment

Theme 5: Risk management, capacity development and country practices

Theme 6: Catastrophic landslides: causes and consequences

Theme 7: Frontiers of landslide science and innovative practices

The 5th of November was designated as "World Tsunami Awareness Day (WTAD)" by 70th session of the UN General Assembly 2015. It recognizes Landslides near a coastline or at the bottom of the ocean as one major causes of Tsunami. Symposia or sessions on landslide – induced tsunami will be organized on 5th November 2020.

Secretariat of the 5th World Landslide Forum

International Consortium on Landslides (ICL)

138-1 Tanaka-Asukai cho, Sakyo-ku, Kyoto 606-8226, Japan
Tel: +81 (75) 723 0640, Fax: +81 (75) 950 0910
Email: secretariat@iclhq.org, URL: http://www.iplhq.org

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Static Liquefaction and Strength Loss in Tailings Dams

Static liquefaction and strength loss of tailings dams due to undrained failure has become a topic of interest in tailings management following the Fundão and Mount Polley tailings dam failures.

Static liquefaction is the sudden loss of strength when loose soil, typically granular material such as sand or silty sand, is loaded and cannot drain. Strength loss due to undrained failure is also associated with fine grained materials of low hydraulic conductivity, such as clays or plastic silts. The two phenomena are related; loading and deformation produces a tendency for the materials to contract and develop excessive pore pressure faster than drainage systems can relieve the pressure.

Static liquefaction is a rare event but happens very quickly and without warning, so it is an extremely dangerous phenomenon. Although it is called static liquefaction, a triggering event usually causes the rapid strength loss. There are many potential triggers, including:

- vibrations from construction equipment (not strictly static liquefaction);
- rise in water pressure in a slope;
- stress increase due to a dam raise;
- stress concentrations due to a higher dam;
- loss of horizontal confining stress due to lateral strains in the foundation or dam (extrusion-related failure).

Much of the risk depends on the in-situ stress regime, which is difficult to measure and monitor.

Static Liquefaction in Upstream Constructed Dams

A key point in understanding static liquefaction is that sands, including tailings sands, can become less dense as the in-situ stress increases, for example as a dam is raised. A material consolidated by desiccation may appear to be dense in an exposed tailings beach, however it can behave like loose sand at higher stress levels. Pre-consolidation due to desiccation effects are usually overcome at vertical stresses of 200 kPa to 400 kPa, equal to a depth of about 15 m to 40 m, depending on the water pressure and tailings density.

The problem faced by many mine sites is that upstream constructed tailings dams are often higher than the 15 m to 40 m range (or are planned to go higher). Since the pre-consolidation benefits are being exceeded as the dams are raised, the previous "good" performance of the dam may not be an indicator of its future performance. This is especially true where there is a clay foundation. Such a foundation can induce lateral strains and decrease horizontal stress, which combined with increased vertical stress, promotes collapse and potential static liquefaction.

Undrained failure in foundation clays can cause deformations in the dam, which generates pore pressures induced by the failure process. This phenomenon was first recognised in tailings dams built over soft ground which failed at much flatter slopes than predicted because the design did not consider shear-generated pore pressure increases.

Clays also become more susceptible to this kind of undrained failure as the confining stress increases. The phenomenon is easier to understand for clays since the concept of pre-consolidation stress is well understood. The pre-consolidation pressure is the maximum past pressure that the clay has been subjected to. This can vary from modest stress imposed by desiccation, to very high pre-consolidation stress imposed by kilometer-thick ice sheets. Pre-consolidation stress can be reliably measured in the lab and confirmed by understanding the geologic history of the site.

The issue for tailings dams becomes acute when the loads imposed by the dam exceed the pre-consolidation stress, or the "apparent" pre-consolidation stress for soils desiccated or weathered in-situ. For in-situ weathered soils, such as tropical clays, it is not uncommon for the apparent pre-consolidation stress to be around 200 kPa to 400 kPa or 15 m to 40 m of fill height. Lightly consolidated lacustrine clays in pro-glacial environments often show similar pre-consolidation stress.

It is not possible to obtain samples of undisturbed sands and silty sands by drilling and it is very challenging to get undisturbed samples of fine tailings, therefore in-situ tests are needed to assess liquefaction. The potential for static or seismic liquefaction in sands can be evaluated with the help of seismic cone penetration tests (SCPTu). These tests can estimate the in-situ void ratio relative to the critical state void ratio at a given depth.

For clays, it is possible to get reasonably undisturbed samples. Laboratory tests can be used to get a reasonable estimate of the in-situ pre-consolidation pressure, and the static and post-seismic drained and undrained strength of the clays.

Conclusion

Tailings dam failures in recent years have shined a spotlight on static liquefaction and strength loss caused by undrained failure. KCB's forensic investigation into both Mount Polley and Fundão have highlighted the role of undrained shear strength in the dam failures, where either clay foundation or tailings can become susceptible to failure as in-situ stress increases.

As dams increase in height, particularly upstream tailings dams, designers need to keep in mind the potential for undrained failure and that the future performance of a dam can change. Care must be taken to not exceed the pre-consolidation or the "apparent" pre-consolidation stress range. The potential strength reduction must also be accounted for in the design.

Upstream constructed dams should be discouraged and extra care is required if they are to be considered. For existing upstream dams, it is best to keep the fill height below 40 m.

For further information, please contact us at info@klohn.com or 604.669.3800.

(Klohn Crippen Berger, April 11, 2018, https://www.klohn.com/blog/static-liquefaction-strength-loss-tailings-dams)

Civil engineering - Nordic style

Eysturoy tunnel in the Faroes will feature a roundabout carved out of rock

The Nordic countries – which are Denmark, Faroe Islands, Finland, Greenland, Iceland, Norway and Sweden – are renowned for their innovative infrastructure solutions. These technologically advanced north-western European states share the challenges of colder climates, difficult terrain and large inter-urban distances, plus opportunities for sustainable growth and regeneration in their major towns and cities.

The Institution of Civil Engineers has showcased some of the most innovative recent and ongoing Nordic infrastructure projects in a new special issue of its Civil Engineering journal (https://www.icevirtuallibrary.com/toc/jcien/171/5). These range from a waste-to-energy plant with a ski slope on the roof to a snow cooling system, an underground roundabout made of rock and the world's biggest microscope.

Sustainable energy

Hulgaard and Søndergaard (2018) start by describing a novel waste-to-energy project in Copenhagen, Denmark. The Amager Bakke facility, the largest project of its kind in Scandinavia, combines ultra-high energy efficiency and environmental performance. Care has been taken to integrate the project into the city, both in terms of appearance and by providing public recreation facilities – including a ski slope – on the roof.

Continuing the energy theme, Moe (2018) reports on an innovative cooling plant at Oslo airport. It uses snow cleared from the runways during winter to help cool the recently enlarged airport terminal buildings in the summer. The plant worked satisfactorily in 2016 and 2017 and is expected to improve following optimisation of snow storage.

Subsea crossings

From air transport we move to road and rail, with Pedersen and Brøndum (2018) describing the concept design for the Fehmarnbelt fixed link between Denmark and Germany. Due to open in 2028, this €7 billion mega-project is an 18 km long immersed tube tunnel with a four-lane motorway and a two-track railway. Demanding requirements from the owner for availability, maintainability and safety have led to a number of innovative design solutions.

On a somewhat smaller scale, Samuelson and Grøv (2018) then cover two new subsea tunnels being built in the Faroe Islands. There are already 20 road tunnels in the islands which, together with hydropower tunnels, equate to about 1·5 m of tunnel for every inhabitant. The majority of these economically vital tunnels are in basalt and constructed using drill and blast.

Underground transport

Staying underground, Andersen et al. (2018) describe the four-track Holmestrand railway station, believed to be the first high-speed rail station constructed in rock. Keeping waiting passengers safe from the noise and aerodynamic effects of 250 km/h through trains required complex modelling and installation of noise barriers, acoustic ceilings, relief tunnels and pressure doors.

Back in Copenhagen, Falbe-Hansen et al. (2018) describe the extensive monitoring of existing structures undertaken as part of the construction of the new Cityringen Metro. The project, comprising 15·5 km of twin bored tunnels, 17 stations and five shafts, passes under the dense urban area of the city centre including many sensitive heritage sites. It is due to open in 2019.

Light rail and neutrons

Bergen in Norway has opted for a light rail transport solution, stage 3 of which is described by Sherry (2018). Completed in 2017, the newly opened 7·8 km section was designed by a project team spread across seven countries using a fully integrated three-dimensional building information model.

In the final paper, Stenman et al. (2018) describe design and construction of what will be the world's biggest microscope.. Due for completion in 2023, the €1·8 billion European Spallation Source at Lund in Sweden is a neutron source which will allow investigation at molecular level in a number of scientific fields. The project entails complex coordination of end-user and regulatory requirements in terms of structural performance, radiation safety and integration of large bespoke specialist scientific equipment.

(Andrew Martin and Colin Rawlings / ICE Civil Engineering Journal Special Issue, 16 April, 2018, https://www.ice.org.uk/news-and-insight/the-civil-engineer/april-2018/civil-engineering-nordic-style?utm_source=Communicator&utm_medium=email&utm_content=Untitled5&utm_campaign=6961381)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Natural cycles: A link between formation of supercontinents and strength of ocean tides

A new study suggests there is a likely link between the cyclic strengthening and weakening of ocean tides over tens of millions of years and another, longer cycle - the formation of Earth's supercontinents every 400 to 600 million years. The new research suggests long-term changes in tidal energy, which control the strength of the ocean's waves, are part of a super-tidal cycle dictated by the movement of tectonic plates, with implications for the formation of our planet, its climate and the evolution of life on Earth.

When tectonic plates slide, sink and shift the Earth's continents to form large landmasses, or supercontinents, ocean basins open and close in tandem. As these basins change shape, they can strike forms that amplify and intensify their tides.

In the new study, tidal simulations projected hundreds of millions of years into the future suggest the Earth is now in the nascent stage of a tidal energy maximum, where strong tides will persist for roughly 20 million years. The oceans will go through several tidal cycles as the next supercontintent forms over the next 250 million years. Eventually, the tides will grow much weaker, just as they did during the two most recent supercontinents: Pangaea and Rodinia, according to the new study published in Geophysical Research Letters, a journal of the American Geophysical Union.

Scientists were aware tidal energy varied in the distant past, but the new study suggests there is a super-tidal cycle occurring over geologic timescales and linked to tectonic movement.

"Our simulations suggest that the tides are, at the moment, abnormally large," said oceanographer Mattias Green from Bangor University's School of Ocean Sciences in Menai Bridge in the United Kingdom and lead author of the new study. "And that really was our motivating question: If the tides were weak up until 200 million years ago, and they've since shot up and become very energetic over the past two million years, what will happen if we move millions of years into the future?"

Tectonic movement dictates not only the placement of Earth's continents, but also the shape and size of its ocean basins. In this animation, tectonic movement is projected millions of years into the future. Viewers can see the continents slowly move toward a supercontinent formation. A new study in Geophysical Research Letters suggests the cyclic strengthening and weakening of ocean tides over tens of millions of years is likely linked to the formation of Earth's supercontinents every 400 to 600 million years. When tectonic plates slide, sink and shift the Earth's continents to form large landmasses, or supercontinents, ocean basins open and close in tandem. As these basins change shape, they can strike forms that amplify and intensify their tides.

Scientists simulated the movement of Earth's tectonic plates and changes in the resonance of ocean basins over millions of years.

The new research suggests the Atlantic Ocean is currently resonant, causing the ocean's tides to approach maximum energy levels. Over the next 50 million years, tides in the North Atlantic and Pacific oceans will come closer to resonance and grow stronger. In that time, Asia will split, creating a new ocean basin, according to the study.

In 100 million years, the Indian Ocean, Pacific Ocean and a newly formed Pan-Asian Ocean will see higher resonance and stronger tides as well. Australia will move north to join the lower half of Asia, as all the continents slowly begin to coalesce into a single landmass in the northern hemisphere.

After 150 million years, tidal energy begins to decline as Earth's landmasses form the next supercontinent and resonance declines. In 250 million years, the new supercontinent will have formed, bringing in an age of low resonance, leading to low tidal energy and a largely quiet sea.

The new study finds each tidal maximum lasts at most 50 million years and is not necessarily in phase with the supercontinent cycle.

(THE WATCHERS, April 12, 2018, https://watchers.news/2018/04/12/natural-cycles-a-link-between-formation-of-supercontinents-and-strength-of-ocean-tides/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

Is there a tectonically driven super-tidal cycle?

J. A. M. Green, J. L. Molloy, H. S. Davies, J. C. Duarte

Abstract

Earth is 180 Myr into the current Supercontinent cycle and the next Supercontinent is predicted to form in 250 Myr. The continuous changes in continental configuration can move the ocean between resonant states, and the semi-diurnal tides are currently large compared to the past 252 Myr due to tidal resonance in the Atlantic. This leads to the hypothesis that there is a "super-tidal" cycle linked to the Supercontinent cycle. Here, this is tested using new tectonic predictions for the next 250 Myr as bathymetry in a numerical tidal model. The simulations support the hypothesis: a new tidal resonance will appear 150 Myr from now, followed by a decreasing tide as the supercontinent forms 100 Myr later. This affects the dissipation of tidal energy in the oceans, with consequences for the evolution of the Earth-Moon system, ocean circulation and climate, and implications for the ocean's capacity of hosting and evolving life.

(First published: 11 April 2018, https://doi.org/10.1002/2017GL076695, https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2017GL076695)

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Volcanic eruptions during Roman times plunged Eurasia into hunger and disease

A joint research project of the Chronology Laboratory of the Finnish Museum of Natural History and Natural Resources Institute Finland (Luke) suggests that large volcanic eruptions in the years 536 and 541–544 CE resulted in unusually gloomy and cold period with little light, making it difficult for humans to survive. The level of production of plants is dependent on the amount of available sunlight. Food production, i.e, farming and animal husbandry, rely on the same solar energy. Humans, meanwhile, become more prone to disease if they are not exposed to enough sunlight to produce vitamin D.

The large volcanic eruptions of AD 536 and 540 led to climate cooling and contributed to hardships of Late Antiquity societies throughout Eurasia and triggered a major environmental event in the historical Roman Empire, study authors say. "Our set of stable carbon isotope records from subfossil tree rings demonstrates a strong negative excursion in AD 536 and 541–544."

Their model based on sixth-century isotopes reconstructs a solar irradiance anomaly for AD 536 and 541–544 of nearly three standard deviations below the mean value based on modern data and authors explain it by a volcanic dust veil reducing solar radiation.

"We offer a hypothesis that persistently low irradiance contributed to remarkably simultaneous outbreaks of famine and Justinianic plague in the eastern Roman Empire with adverse effects on crop production and photosynthesis of the vitamin D in human skin and thus, collectively, human health. Our results provide a hitherto unstudied proxy for exploring the mechanisms of 'volcanic summers' to demonstrate the post-eruption deficiencies in sunlight and to explain the human consequences during such calamity years."

The results of the study are based on the analysis of the variation of carbon isotopes in the annual growth rings of trees. The variety in carbon isotopes reflects the photosynthesis of the trees, which in turn is largely dependent on the amount of solar radiation available during the summer.

The unusually poor years coincide with the bubonic plague epidemic that devastated the Roman Empire. The epidemic caused by the Yersinia pestis bacterium began in 542 CE and killed approximately half, or more, of the inhabitants of what was then considered the Eastern Roman Empire. The plague spread through Europe, from the Mediterranean, possibly as far north as Finland, and had killed tens of millions of people by the 8th century.

Reference:

Volcanic dust veils from sixth century tree-ring isotopes linked to reduced irradiance, primary production and human health - Samuli Helama et al. - Scientific Reports - doi:10.1038/s41598-018-19760-w - OPEN ACCESS

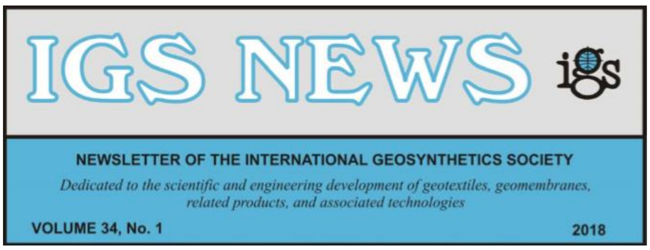
(THE WATCHERS, April 11, 2018, https://watchers.news/2018/04/11/volcanic-eruptions-during-roman-times-plunged-eurasia-into-hunger-and-disease/?utm_source=feedburner&utm_medium=email&utm_campaign=Feed%3A+adorraeli%2FtsEq+%28The+Watchers+-+watching+the+world+evolve+and+transform%29)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

https://www.issmge.org/filemanager/article/518/ISSMGE_BULLETIN_2018_APR_FINAL.pdf

Κυκλοφόρησε το Τεύχος 2 του Τόμου 12 του ISSMGE Bulletin με τα παρακάτω περιεχόμενα:

- Research highlights – Delft University of Technology, The Netherlands
- Message from the Corporative Associates Presidential Group (CAPG)
- Report from the Kazakhstan Geotechnical Society
- Conference reports
  - The 3rd Int. Conf. on Ground Improvement and Ground Control, China
  - Annual Conference of the Italian Geotechnical Society, Italy;
  - The 2nd Pan-American Unsaturated Soil Conference, Dallas, USA 45 Hot news
  - The 8th Int. Symp. on Environmental Vibration and Transportation Geodynamics, China
  - The 2nd Young Transportation Geotechnics Engineers (YTGE) Meeting, China
- ISSMGE Foundation reports
- Event Diary
- Corporate Associates Foundation Donors



http://www.geosyntheticssociety.org/wp-content/uploads/2018/04/IGS-News-Vol34-Issue1.pdf

Κυκλοφόρησε το Τεύχος 1 του Τόμου 34 των IGS NEWS της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

https://www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/46/issue/2

Κυκλοφόρησε το Τεύχος 2 του Τόμου 46 του περιοδικού Geotextiles and Geomembranes με τα παρακάτω περιεχόμενα:

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ITACET Foundation
Foundation for Education and Training on Tunnelling and Underground Space Use
Newsletter #28
April 2018

Κυκλοφόρησε το Τεύχος #28 του **Newsletter** του **ITACET Foundation** (Απριλίου 2018) με τα παρακάτω περιεχόμενα:

Editorial

Training session reports

- Control and Monitoring of Tunnels and Underground Space
- Flood Control And Tunnelling
- Underground Space Use
- Structural Use of Fibre-Reinforced Concrete in Precast Segments

Forthcoming sessions

- WTC 2018: Main Opportunities and Technical Issues in Tunnelling

Other events in preparation

- Mexico – "Choice of Excavation Method" – May 2018
- Chile - "Mechanized Tunnelling" - May 2018
- Italy / France - "Long Tunnels at Great Depth" - June 2018
- Argentina - "Management of User Safety" - September 2018
- China - "Utility tunnels" - date not yet fixed
- Brazil - "Innovations in Tunnelling" - date not yet fixed

Foundation scholarship recipients

- Pushing a Career in Tunnelling to the Next Level
- Parlez-Vous Tunnels? News from our Scholarship Student in France

Other news

- IRF Global Road Conference: 7th-9th November 2018
- A Successful Council Meeting in Paris

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