Δρόμοι στην Τρανσυλβανία

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

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Innovation: Stepping up the Industry

We talk a lot about innovation in our industry. Most of the leading consultants include innovation as a key company attribute on their websites. Each year we celebrate innovation in the many awards ceremonies that take place around the world. And clearly there are plenty of examples of innovation in the projects we deliver. **Yet innovation is not routine. We struggle to build the processes that lead to innovation into our day to day work**. Even though we know that we must innovate more if we are to secure the success of the industry, and our share of it, in the future.

At the start of my presidential year I set my seven apprentices the task of understanding why we find innovation elusive and what we might do to address that – to make it part of our day to day business. I asked them to learn from the exemplar projects where innovation has delivered success for designers, contractors and clients. This is their report (https://www.ice.org.uk/ICEDevelopmentWebPortal/media/Disciplines-Resources/presidents-apprentices-2015-final-report.pdf). I hope you find it informative and practically useful. By adopting its findings you will be able to drive innovation into your own organisation. And together we will reshape the future of our industry.

Professor David Balmforth
President
Institution of Civil Engineers
October 2015

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

ΑΡΘΡΑ

Παρουσίαση άρθρων, στην συγγραφή των οποίων μετείχαν Έλληνες, στο XVI European Conference on Soil Mechanics and Geotechnical Engineering, Edinburgh, 13-17 September 2015 (κατ' αλφαβητική σειρά, στα ελληνικά, του ονόματος του πρώτου συγγραφέα).

Capital & Operational Carbon - an assessment of the permanent dewatering solution at Stratford International Station

Carbone - Capital & Opérationnel - une évaluation de la solution de déshydratation permanente à Stratford International Station

G. Casey, H. Pantelidou, D. Whitaker, N. O'Riordan, K. Soga and P. Guthrie

ABSTRACT The cost and carbon implications of the link between design stage and operational performance are the subject of this piece. Stratford International station is located on the UK's only existing High Speed Rail line. The piezometric level in London has been rising since the 1960's as a result of the majority of the heavy industry relocating away from London. The long-term groundwater levels are not known with certainty, affecting the design of foundations and underground structures in the area. The CTRL project was at a critical junction during this design period in 1996 and capital financial cost reductions were required to secure its existence. The permanent dewatering solution was selected based upon the £21.8million saving it afforded over a tension pile solution. This paper reviews the long-term implications in terms of cost and carbon emissions, of a decision criterion revolving around capital cost alone. The long-term impact becomes further complicated within the context of the unforeseen recent large-scale development of the Stratford area. Carbon is selected as a metric to assess the sustainability of the solution, in view of what lessons should be fed back from asset operation to design. Financial cost is also considered, comparing the capital financial decision to the operational cost of the asset.

1 CTRL & THE STRATFORD BOX

The Channel Tunnel Rail Link (CTRL) is the UK's only high-speed rail line, running 108km from St Pancras in central London to the Channel Tunnel entrance at Folkestone. The project reduced the journey time from London to the Channel Tunnel by half and through this, allowed travel to Paris in just over two hours. The CTRL project also fulfilled an important role in encouraging regeneration in the wider East London. Development in the Stratford area was a key local and national focus. Stratford International now offers high-speed services to St Pancras, Faversham, Margate, Dover Priory, as well as Eurostar services to continental Europe (through Ebbsfleet or St Pancras). In more recent times, the Stratford area became the home of the London 2012 Olympic Games and now features extensive development in the form of retail and leisure space, hotel space, commercial district space, residential homes and community facilities, largely triggered by the London Olympics Legacy.

The CTRL horizontal alignment and tunnel safety regulations required a subsurface reinforced box to achieve a satisfactory vertical alignment and allow for a high speed station in the area. The Stratford box consists of a 1072m long, 38m to 55m wide and 13m to 26m deep diaphragm wall box with plunged columns. The centre of the box features the station platform area, with 1.5m cantilevered flat panels used to provide unobstructed access. At the East and West ends of the box, there are thinner, 1.2m flat panels which are propped using traditional waling beams and struts. These walls are propped by an unreinforced concrete slab, forming the base for the track ballast. A plan view of the Stratford box is shown in Figure 1.

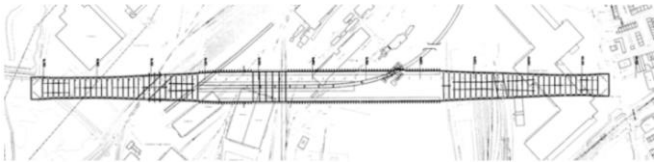

Figure 1 Stratford Box. Stratford Preliminary Design Development Report (RLE, 1996)

The Rail Link Engineering (RLE) consortium of Arup, Bechtel, Halcrow and Systra was formed to design and manage the CTRL project.

2 THE TECHNICAL PROBLEM

The Stratford box design had to address the problem of future groundwater levels in the underlying Chalk aquifer. Historic water abstraction, primarily for industrial use since the industrial revolution in and around London, resulted in the suppression of groundwater levels in the Chalk aquifer. Since the 1960's, this abstraction has declined dramatically and the groundwater level has been rising consistently towards its pre-industrial levels (Simpson et al, 1989). This groundwater level rise has become a concern for many areas of London, increasing the risk of ground movement and instability of foundations and underground structures. The Stratford area has witnessed a change in the piezometric surface of approximately 10m from 1953 to 1997, as is seen in Figure 2.

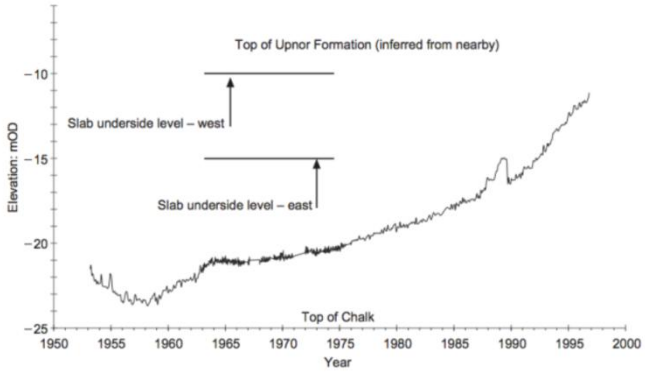

Figure 2 Groundwater levels 1950-1995, Stratford Goods Yard, TQ38/59B (Whitaker, 2004)

It has estimated that without this historical abstraction, this old marshland area would have a piezometric surface of around +6 mOD, effectively at original ground level (Downing et al, 1972). The design considered that the "consequences of flotation of the box are onerous in terms of both reconstruction costs and disruption to the CTRL system" (RLE, 1996), adopting +7mOD for the long term design water level.

Stratford has two aquifers: the upper consists of superficial deposits of Made Ground, Alluvium and River Terrace Deposits. The lower aquifer is in the Upnor and Thanet Sand formations underlain by Upper Chalk and is separated from the upper aquifer by the clays of the Lambeth Group (previously known as Woolwich and Reading Beds). At the time of design in 1996, the ground water level was almost at the top of the Thanet Sand layer (approximately -8 mOD).

3 THE ENGINEERING OPTIONS

For the assessment of the uplift potential, there was uncertainty on the long-term groundwater level. Figure 2 shows the groundwater level rising at a considerable rate in the early 1990's, increasing at nearly 1m per year, potentially returning to their preindustrial abstraction levels.

For the station box design, RLE eventually considered the following two engineering options for resisting uplift from the long-term water pressures:

- Tension piles
- Dewatering

The pile and dewatering solutions were appraised in further detail.

3.1 Tension Piles

The pile design featured 1.5m diameter piles at 10m longitudinal centres with embedment of 13m into the chalk. The slab base level fluctuated as did the pile lengths. A total of 250No 38m-length piles were estimated for the central, widest section of the box; 200No 28m-length piles were required for the tapered ends of the box. The pile solution increased the loads transferred to the box structure and therefore required a more heavily reinforced base slab and diaphragm walls. A cost analysis estimated the piling solution to be £36.7million.

3.2 Permanent Dewatering

The permanent de-watering system was required to maintain a water level at -10mOD and able to cope with a full return to the historical groundwater level of +7 mOD in the area.

Temporary de-watering was already required for excavations and construction of the base slab, as well as for constructing shafts, cross passages, sumps, approach structures and also helping with the TBM efficiency and user safety.

Permanent dewatering acts appropriately to ensure a water level of 10m below the base slab. In contrast, the tension pile solution would have been designed with a high factor of safety to at least resist the +7 mOD groundwater level.

At the design stage, two dewatering solutions were considered: one simple pumped system and another also featuring passive wells and drainage blanket. In the event of a pumping hardware or power supply failure, the box would have a limited time period before which significant damage would occur as a result of the increasing uplift pressures. Although the passive well and drainage blanket would allow a longer period (nearly 2 months) of pump failure, its capital cost was higher by approximately £3million.

The capital cost of the simple pump system was estimated as £14.9 million, allowing for a maximum period of 24-hours pump failure before structural damage occurred (ie recovery of water levels to +7mOD). Thus, there was a need to ensure a sufficient level of backup redundancy for this system. A detailed quantified risk assessment (RQA) was carried out to assess the impacts of pump failures, hardware lead times and repair time scales. Through a combination of electrical and power supply arrangements, an acceptable level of reliability was found.

The abstraction occurs from deep wells into the chalk. 22 design wells were specified, based upon a peak demand of 170 l/s for the entire Stratford box. The location of these wells is shown in Figure 3. The yield of each well was specified as 10 l/s, allowing for a 30% overcapacity, to ensure a sufficient factor of safety (although 12 l/s was achieved). Each well featured a 300mm stainless steel casing and a 250mm drop set stainless steel screen. The casing extended 3-4m into the chalk, to ensure a sufficient amount of drawdown was achieved as efficiently as possible. The wells penetrated 30m into the chalk. Each well was acidised to improve performance.

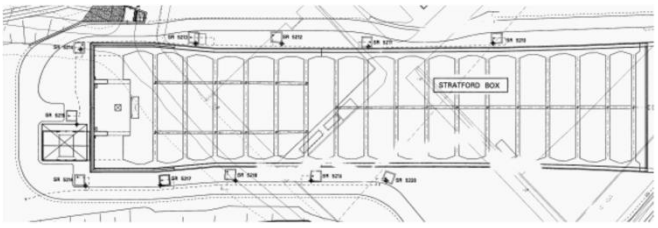

Figure 3 Dewatering well locations in Stratford Box (RLE, 1996)

4 THE DECISION MAKING PROCESS

In late 1996, the CTRL project was under considerable financial and political pressure. There was a need to reduce capital expenditure, if the project was to go ahead. This austere background led to a programme of value engineering workshops, which achieved an estimated £33m reduction of capital cost across the entire CTRL project. In early 1997, permanent dewatering of the Stratford box was recommended on the basis that it was "the minimum capital cost solution."

5 A CHANGING ENVIRONMENT

5.1 Underwriting the design level

The greatest challenge for the design was agreeing the long-term design groundwater level with insurers and stakeholders. Varying piezometric scenarios were suggested and each scenario had a different engineering solution. There was a wider political activity concerned with the rising groundwater levels in London. Around the same time of design, the General Aquifer Research Development and Investigation Team (GARDIT) strategy was launched by Thames Water, the Environment Agency, Transport for London, the Corporation of London, Envirologic, the Association of British Insurers and British Telecom (GARDIT, 1996). The purpose of GARDIT was to increase extraction of groundwater supply so as to stabilise the groundwater levels in the Chalk aquifer. The CTRL extraction now forms a part of this wider ambit GARDIT programme. CTRL are now the guarantors of the water level for a 3km radius, for an 80-year period.

5.2 Wider development

The CTRL alignment through Stratford was envisioned to spearhead a wider regeneration strategy. The development that has occurred in the area since the late 1990's has been significant and wide spread. An area, which was predominantly a brownfield site in the 1990's, is now the home of a multi-billion pound development which features a host of Olympic legacy sporting facilities, housing and commercial premises and attracts more future development.

As a result, significant construction projects have also influenced the groundwater level in the area. The Power Cables Under Ground (PLUG) project was carried out by National Grid and EDF to divert the aerial high voltage distribution cables underground at the Olympic Park. The construction of the energy tunnels required dewatering from 2005 until 2012. Further development has occurred and continues to occur in Stratford, as part of the Olympics Legacy masterplan. Such development has generally shorter design life than the Stratford Box. It has been designed and constructed for the lowered groundwater level underwritten by CTRL (-10mOD) and benefitted from the associated lower

construction costs. A tension pile system at Stratford box would have resulted in a less attractive area for developers, with a higher cost in dealing with the higher water table.

5.3 Potable Supply

London is expected to experience increasing water stress in the future. Thames Water is responsible for sourcing strategic supplies to secure future supply. The dewatering design intended that the extracted water could be used for public supply and Thames Water has been licensed to abstract from Stratford since 1st January 2009. However, records since 2009 until 2014 provided by Dr Michael Jones at Thames Water show that this resource has only been used over a period of 6 months, with a total of 480ML abstracted from April until November 2012.

6 CARBON COMPARISONS

Engineers are increasingly required to consider carbon in their decision making process, in a bid to make more sustainable, but also more cost-effective design decisions (HM Treasury, 2013).

The permanent dewatering solution at Stratford was selected due to its lower capital cost; whole life carbon and cost were not considered at the time of the CTRL design. This review of the operational data available tests the long-term implications of the permanent dewatering solution, by comparing to the alternative tension pile solution in terms of its carbon footprint.

The boundary for this analysis has been drawn to only include only the differences between these two contrasting engineering solutions. The majority of the carbon capital footprint of the Stratford box is shared and so only the aspects associated with the piles or dewatering are included.

6.1 Capital Carbon

6.1.1 Tension Pile

A study by Chau et al. (2011) showed that pile-slab structures are dominated by material embodied (capital) energy/ carbon. Due to this, the scale of the CTRL project and to simplify the calculations, the transportation of materials to site was excluded. Uncertainty in the carbon attribution of materials is reflected in the range given in Figure 4.

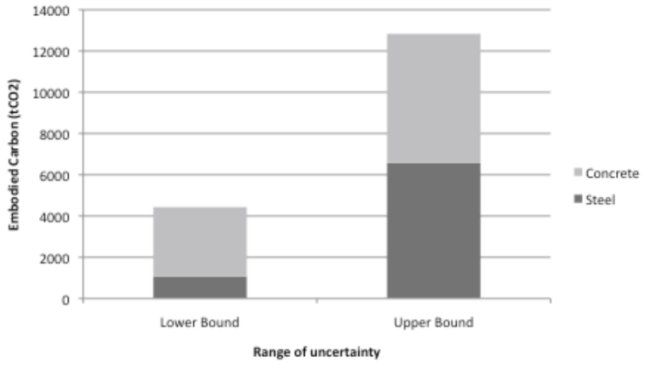

Figure 4 Tension pile capital carbon range

6.1.2 Permanent Dewatering

The capital carbon of the solution was estimated using the as built drawings and technical specifications; they are illustrated in Figure 5.

6.2 Operational Carbon

6.2.1 Tension Pile

This design was assumed to have no operational costs.

6.2.2 Permanent Dewatering

Actual dewatering abstraction records from the Stratford box were not available for review at the time of writing. An estimate of the abstraction quantities is based on the annual abstraction estimations by the EA (2014). Abstraction volumes for the Stratford area are given for two different years. The single biggest dewatering scheme in the area is the Stratford box and so this value can be attributed to its operation.

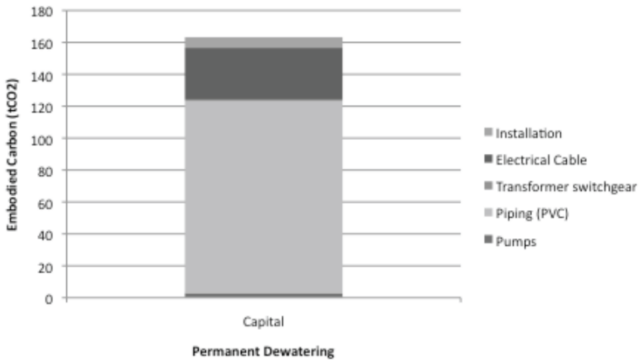

Figure 5 Permanent dewatering capital carbon

There is little information available on how this abstraction has evolved since its installation. As would be expected, pumping has increased in more recent time as the water level has continued its recovery and nearby dewatering schemes have seized. A coarse indication of pumping rates since 2002 is based on a linear interpolation of the available data. These values, combined with pumping specification, allowed for an estimation of the carbon emissions, as displayed in Figure 6.

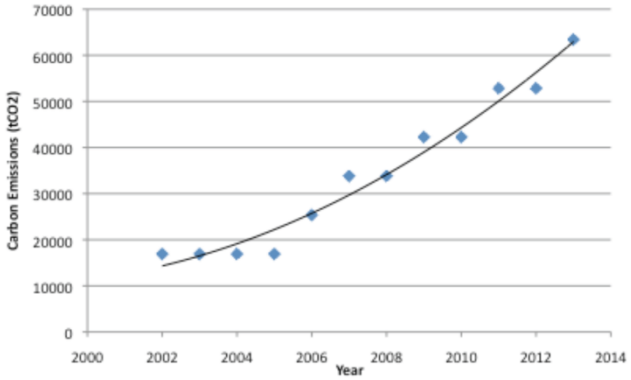

Figure 6 Estimated carbon emissions from permanent dewatering (2002 to 2013)

6.3 Comparisons to date

The CTRL project has an 80-year year design life. Figure 7 shows the estimated comparative carbon costs from 2002 to 2082.

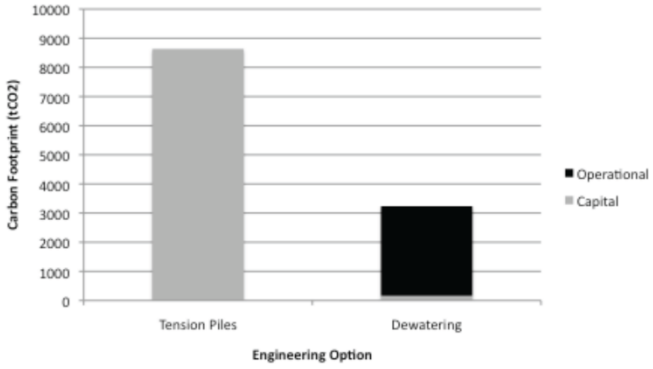

Figure 7 Tension pile and dewatering capital and operational carbon comparison *the mean capital carbon is adopted for tension pile option

These two solutions offer an interesting carbon comparison, as their footprints contrast considerably. The tension pile solution is almost entirely a capital carbon cost, with no operational carbon cost accrued over the use of the infrastructure. Conversely, the dewatering solution has little carbon invested in its construction, rather the majority is found in its operation. The carbon credentials of the dewatering are closely linked to the carbon cost of its electrical supply and should improve as decarbonisation of the energy supply continues. Such contrasting carbon attributes lead to difficulty in their comparison. Traditionally, carbon assessments have focused on the capital material, embodied carbon cost, as it is generally the predominant aspect. However, such methodologies are not appropriate for operationally dominated activities, such as permanent dewatering, as is shown in Figure 8. This case study illustrates how such methodologies, if used at design appraisal stage, could lead to short sighted decisions.

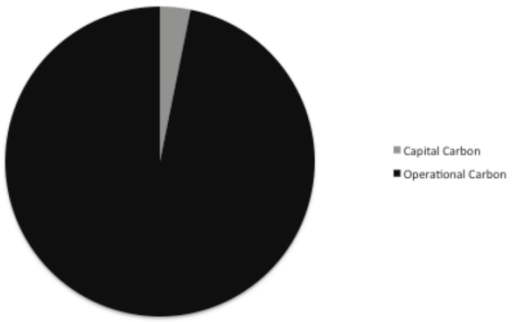

Figure 8 Estimated capital and operational carbon split of permanent dewatering for 2002 to 2082 time period.

7 FINANCIAL COST COMPARISON

Based upon estimations from 2002 until 2013, costs are extrapolated to 2082. There is significant uncertainty surrounding future energy prices, they were assumed to grow at the same rate as the 2002-2013 period. It is shown in Figure 9 that the dewatering solution has had a lower financial cost. However, projecting into the future considering energy price possibilities show a significant liability. Since 2002, when the box was constructed, until 2014, electricity prices have increased by 100% (Bolton, 2014).

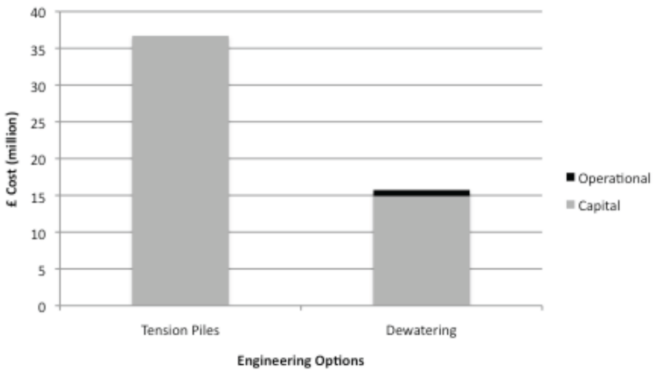

Figure 9 Capital and operational financial comparison of dewatering and tension piles for 80-year design life

8 CONCLUSIONS

From this analysis, it is clear that the design of large infrastructure projects cannot account for all future development scenarios. It would not have been possible for the designers in 1997 to foresee the development that has occurred in the Stratford area in the past 15 years.

The difficulty in contrasting engineering options, which are capital or operational carbon heavy has been highlighted. This has been a much needed carbon and cost case study, which, against all expectations, demonstrated the dewatering option to be a whole life cost and carbon preferred solution. However, there is still a real need to better consider how externalities may impact on this design into the future.

As concerns grow over energy security, it is imperative that the QRA is reassessed and necessary measures taken if required. The recent developments take the current water level as granted and have made little consideration for it rising. In the event of dewatering failure, the ramifications are no longer limited to damage to the CTRL itself.

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Dealing with Sediment: Effects on Dams and Hydropower Generation

Greg Schellenberg, C. Richard Donnelly, Charles Holder and Rajib Ahsan

How do reservoir sedimentation and appropriate management techniques affect operations of dams and hydroelectric facilities? The authors cover the topic and provide illustrative case studies, including the 2,100 MW Aswan High Dam in Egypt.

Although sedimentation of the world's reservoirs represents a serious threat to the sustainability of hydropower, there is limited guidance on how best to address the problem. Sedimentation affects the safety of dams and reduces energy production, storage, discharge capacity and flood attenuation capabilities. It increases loads on the dam and gates, damages mechanical equipment and creates a wide range of environmental impacts. This article explores sedimentation issues as they pertain to hydropower facilities, dam safety and the environment; discusses sedimentation management techniques; and describes how they can be implemented to limit the impacts on hydropower.

Background

Reservoir sedimentation is a process of erosion, entrainment, transportation, deposition and compaction of sediment carried into reservoirs formed and contained by dams. In unregulated, mature rivers with stable catchments, sediment processes are relatively balanced. Construction of a dam decreases flow velocities, initiating or accelerating sedimentation,[1] resulting in progressively finer materials being deposited (see Figure 1).

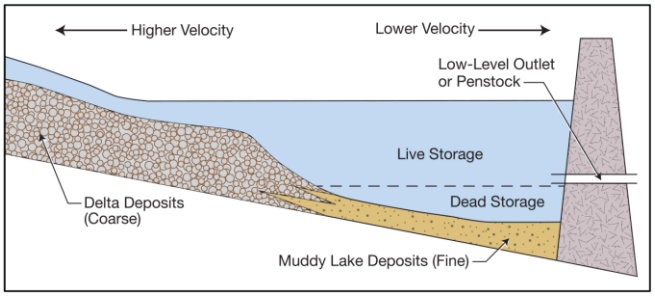

Figure 1 — Typical Reservoir Sediment Profile*
Typically, sedimentation in the reservoir behind a dam takes the form of progressively finer materials being deposited as the flows approach the dam.
*Adapted from Morris, G.L. and J. Fan, Reservoir Sedimentation Manual, McGraw-Hill, New York, 1998.

There are three stages in a reservoir's life:[2]

• Continuous and rapidly occurring sediment accumulation;

• Partial sediment balance, where often fine sediments reach a balance but coarse sediments continue to accumulate; and

• Full sediment balance, with sediment inflow and outflow equal for all particle sizes.

Most of the world's reservoirs are in the continuous accumulation stage.[2] Many were designed by estimating sedimentation rates in order to provide a pool with sufficient volume to achieve a specified design life. However, this design life is typically far less than what is actually achievable. Therefore, managing reservoirs to achieve a full sediment balance is essential in order to maximize their lives.

Developing regions of the world that stand to benefit most from hydroelectricity are often those with the highest sediment yields (see Figure 2).[3] In these regions, sustainable hydropower development must involve consideration of sediment management techniques during design, construction and operation.

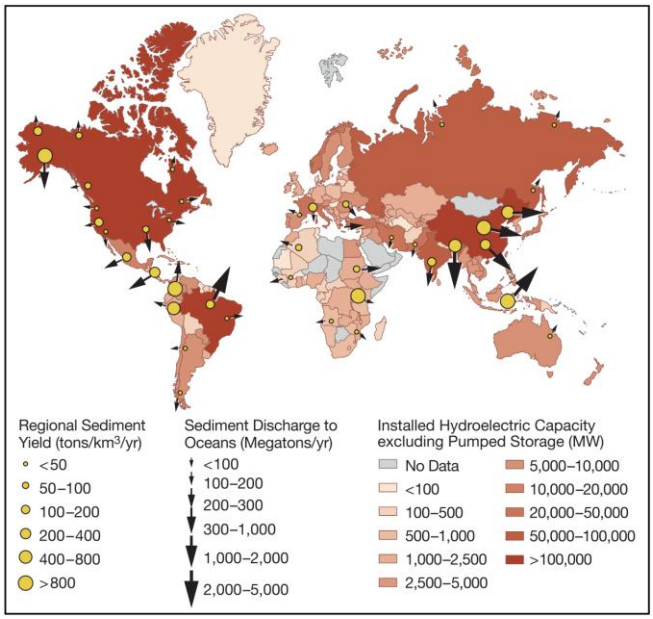

Figure 2 - Comparison of Hydroelectric Potential and Sediment Production*
Developing regions of the world that stand to benefit most from production of hydroelectricity are often those with the highest sediment yields.
*Installed capacity data and sediment yield data adapted from International Hydropower Association 2015 Hydropower Status Report, figure adapted[16]

Sediment impacts on generation

About 0.5% to 1% of the total volume of 6,800 km^3 of water stored in reservoirs around the world is lost annually as a result of sedimentation.[2] As a result, global per capita reservoir storage has rapidly decreased since its peak at about 1980. Current storage is equivalent to levels that existed nearly 60 years ago.[2]

Loss of reservoir storage reduces flexibility in generation and affects the reliability of water supply. Without storage, hydropower facilities are entirely dependent on seasonal flows. These flows might not occur when energy is needed, eliminating one of the key benefits that hydropower provides over other renewables.

Sediments discharged from an upstream dam in a cascade system can increase tailwater levels, reducing power generation.[1] This would impact the generation potential of all plants in the cascade and increase the possibility of powerhouse flooding.

Sediment impacts on stability

Sediment loads are commonly idealized as a static at-rest soil pressure. The U.S. Bureau of Reclamation's design manual for small dams suggests that sediments be considered equivalent to a fluid with an implied pressure coefficient of about 0.39 and an internal friction coefficient of about 37 degrees.

However, actual reservoir sediment properties can vary considerably. Unconsolidated fine-grained sediments likely have lower shear resistance and a higher at-rest pressure coefficient, while a reservoir filled with coarser sediments may have a higher shear strength.[1]

Published criteria with respect to potential changes in uplift pressures due to sedimentation often neglect the fact that fine-grained sediments may reduce uplift in the same man-

ner as does an engineered upstream blanket. Conversely, in the case where there is a large turbid inflow, higher uplift pressures would be expected until enough particles had settled to form a blanket.

During a seismic event, it is likely that liquefied sediments would quickly return close to their original state, resulting in a rapid dissipation of pore pressures. Therefore, it may be questionable to automatically assign higher uplift pressures in this case.

Commonly used design considerations can omit some plausible load cases. For example, an underwater sediment slope failure could cause surface waves, adding additional loading, hydro-dynamic pressure waves and an inertial loading from the dense fluidized soil-water mass. Another phenomena commonly ignored relates to turbidity currents in reservoirs. Such turbid fluid with a sediment load of 100 mg/l could be about 6% heavier than clear water.[1]

Submarine landslides are widely studied because of their potential to create tsunami waves. However, designers also need to consider the potential that failure of the steeply sloped deltaic front could increase loading and produce compression waves that may fluidize finer sediments near the toe of the landslide. As the deposition advances toward the dam, the potential for issues progressively increases.

It is often assumed that, during an earthquake, sediments fully liquefy, lose all strength and exert a dense fluid hydrostatic load on the dam. However, this degree of fluidization likely is not possible in a reservoir filled with coarse materials. Designers also often assume that the fully fluidized dense fluid contributes to hydro-dynamic pressure loading based on Westergaard's formula, ignoring the physical basis for its derivation. In fact, there is some question about the applicability of Westergaard's formula for hydro-dynamic pressures.

Designs also need to consider the degree of saturation of the sediments. There is minimal system damping under dynamic loading when reservoir sediments are fully saturated. However, significant reductions in acceleration occur when sediments are partially saturated.[4,5] For rigid foundations, hydrodynamic pressures decrease slightly at the dam base when sediments are fully saturated but increase when partially saturated.[4] Partial saturation will increase the system's response to horizontal ground movement.[5] Sediment thickness is an important consideration, especially when the sediments are partially saturated.[5] Thin layers result in minimal absorption of horizontal motions, largely due to a relatively high modulus of elasticity and low attenuation coefficient.[6] Over the reservoir life cycle, this changes as sediments continue to accumulate.[7] Other important factors are sediment density, compressibility and pore water pressure.[5,7]

This dependence on sediment properties makes a strong case for their measurement and inclusion as part of the design.[4] However, designs are performed before sedimentation occurs and the same sediments that are stable under normal conditions and absorb energy at the bottom of the reservoir could liquefy. For this reason, the use of a reservoir bottom reflection coefficient must be logically linked to assessment of the reservoir sediment behavior and ongoing monitoring.

Sediment impacts on discharge capability

Sediments will often block low-level outlets designed to

allow for reservoir drawdown.[1] As sedimentation continues, clogging of spillway tunnels or other conduits may occur.[1]

Reduction of spillway capacity can occur as a result of the loss of approach depth when the sediment front reaches the dam. The reservoir becomes a delta-filled valley that takes a meandering course such that a flood wave does not spread out to allow flood routing.

Sediment impacts on equipment

Sediment can damage turbines and other mechanical equipment through erosion of the oxide coating on the blades, leading to surface irregularities and more serious material damage.[8] Sustained erosion can lead to extended shutdown time for maintenance or replacement.[8]

Many factors determine rates of mechanical abrasion. Of particular importance is sediment type and physical characteristics. Angular sediments composed of minerals with a Mohs hardness greater than 5 — such as quartz, feldspar and tourmaline — are problematic. In addition, hydraulic and facility operation parameters such as flow velocity, hydraulic head, turbulence, turbine rotation speed and turbine material affect abrasion susceptibility. Impulse turbines, such as Pelton or Turgo, are more susceptible to abrasion than are reaction turbines.[8] However, runner changes and needle tip/seat ring replacement are much easier with Pelton turbines. Therefore, they may be preferable on the basis of the overall life cycle cost.

Abrasion can be reduced by selecting metals to increase erosive resistance and/or by reducing the volume of fine sediment that reaches mechanical equipment. Plants often are designed to remove most of the coarse sediment particles. However, even silt can cause significant abrasion if the quartz content and pressure head is high enough.[9] The 1,500 MW Nathpa Jhakri hydroelectric plant in India used four desilting chambers that were successful in removing coarser sediments. However, damage from the finer particles was so severe that parts of the turbines had to be replaced within one year.

Materials used commonly in sediment-prone hydropower plants are stainless steels that are heat treated for hardening and increased protection from abrasion.[8] Protecting mechanical equipment from sediment abrasion can also be achieved with hard surface coatings of ceramic paints or pastes or with hard facing alloys.[8] Research has shown improved resistance to sediment abrasion when tungsten carbide-based composites are used as a surface coating.[8] In undertaking such assessments, it is important to consider the fact that abrasion will increase as the reservoir fills. The Nozaki method can be used to assess turbine repair frequency. The method accounts for the effective sediment concentration, particle size and shape, the turbine material and any coatings.

Turbine designs need to minimize peak velocities to reduce impacts. For a Pelton turbine, fewer jets and larger runner buckets with larger radii reduce centrifugal forces between the sediment and runner surfaces. Regardless of the turbine selected, designs must consider issues such as the ease of runner removal for future maintenance.

Sediment impacts on the environment

Any dam will cause some degree of sediment starvation downstream. Plant and animal species are sensitive to alteration of both the sediment supply and flow regime.[2,10] Increases in sediment concentration can create turbid waters with a smaller euphotic zone. This decreases plant productivity, negatively impacting fish and bird species[2] and causing abrasion of fish gills, thus increasing potential for disease or mortality. Turbidity can also cause visual impairment for predatory fish, affecting their feeding habits. Finally, sediment is a primary carrier of suspended pollutants such as nitrogen, phosphorous and heavy metals.[10]

Sediments released as a result of sediment management or a dam breach may have environmental effects that can persist for decades.

Numerical modeling of sedimentation and sediment management strategies

A variety of tools are available for hydromorphological simulation in order to optimize reservoir management:

• U.S. Army Corps of Engineers' HECRAS model features a movable boundary sediment transport calculation module that was recently used to simulate sedimentation processes resulting from hydropower development in northern Manitoba.[11]

• MIKE 21 is a two-dimensional hydrodynamic model used to simulate sedimentation processes that was used to assess sediment deposition patterns and simulate the results of future flushing operations at Boegoeberg Dam in South Africa.[12]

• The hydrodynamic, sediment transport and physical habitat model FAST is used to simulate morphological processes and changes to fish habitat within alluvial rivers.[13] It was used to predict hydromorphological conditions and to optimize sediment flushing procedures prior to constructing new hydropower facilities on the Nile River.

Sediment management solutions

Developing and retaining sustainable storage to satisfy global needs requires inclusion of reservoir sediment management practices at project conception and throughout its life cycle. These practices vary depending on the tope of facility. For run-of-river projects, sediment management aims to remove sediments that can cause abrasion of the turbines and clog cooling water intakes. In a storage project, this objective and extending reservoir longevity are key.

For storage hydro, sediment management strategies to extend reservoir longevity can be classified into three categories:

• Those that divert some of the sediment through or around the reservoir;

• Those that remove or rearrange sediment that has already been deposited; and

• Those that minimize the amount of sediment reaching the reservoir from upstream.

Many dam operators have implemented sediment management techniques designed to achieve these goals.[14] Some examples are described below.

Bypassing

On-stream sediment bypassing diverts part of the sediment-laden water around the reservoir, typically using a weir that operates during high flows when sediment concentrations are high.

An off-stream reservoir can be used such that only the clear water is diverted over a bypass weir. An off-stream reservoir typically has limited capacity and can only exclude sediments carried by higher streamflows.[2] However, it does reduce the amount of suspended sediment and bedload reaching the reservoir.[14] Other advantages include the fact that the reservoir and dam are located away from the main river channel, allowing for minimal disruption to aquatic species and habitat and reducing the need for large on-stream spillways.[2] On the other hand, off-stream reservoirs typically do not permit maximization of generation capacity, especially in areas that depend on high stream flows occurring over a short period of time.[2]

Sediment bypassing works best in areas of high relief where the sediment-laden flows are carried efficiently through the diversion tunnel or channel. Bypassing is most cost-effective at dams that are on the bend of a river, as this allows for a relatively short diversion between the weir and the downstream side of the dam.[14]

Sluicing/drawdown routing

This technique involves lowering the reservoir water levels in advance of high streamflows so that water and sediment can be routed through the spillway at high velocities. Refill occurs during the receding limb of the flood hydrograph.[2,14] Sluicing methods depend on the facility's hydrologic characteristics and reservoir size.

Dredging

Dredging can be efficient but it will continue for the life of the project and can have significant cost impacts. For example, dredging of 6 million m^3 of sediment at the Loiza reservoir in Puerto Rico in 1997 cost $\$10/m^3$.[1,2]

Flushing

Flushing involves emptying the reservoir by opening bottom outlets and allowing the incoming streamflow to scour sediment.[2,14] The effectiveness varies but, generally, only a "core" of sediment along the original channel thalweg is flushed. Sediments on the sides of the reservoir remain in place.[2]

An alternative method is pressure flushing, where the reservoir is partially drawn down before flushing. This redistributes coarse upstream sediments closer to the dam, alleviating their impacts, but often does not clear the finer sediments.[2] Pressure flushing is also used for sediment edistribution, moving them to a less sensitive location.

Erosion control

Many watersheds experience increased erosion rates due to land use and other human practices. Erosion reduction techniques fall into three categories: structural or mechanical, vegetative and operational.[1]

Structural or mechanical measures — such as terraces, conveyance channels, check dams and sediment traps[1,14] — decrease overland or channelized flow velocity, increasing surface storage and thereby reducing the sediment load in the runoff.

Vegetative erosion control takes advantage of plants' natural ability to limit erosion. Agricultural practices that minimize sediment yield are particularly effective.

Operational measures minimize erosion through planning, management and organization. Examples include timing construction work such that erosion is minimized or scheduling timber harvesting to coincide with favorable soil conditions.[1]

Erosion management is perhaps the most widely recommended but most poorly implemented sediment management technique because land users may not see any direct benefits from controlling sediment yield.[2]

Selection of optimal sedimentation management techniques

The appropriate sedimentation management practice is a function of the reservoir life, expressed as the ratio of reservoir volume (CAP) to mean annual sediment inflow to the reservoir (MAS), and retention time represented as a function of the ratio of CAP to the mean annual incoming flow (MAF). Selection of the optimal sediment management techniques can be estimated based on precedent experience and these factors (see Figure 3).

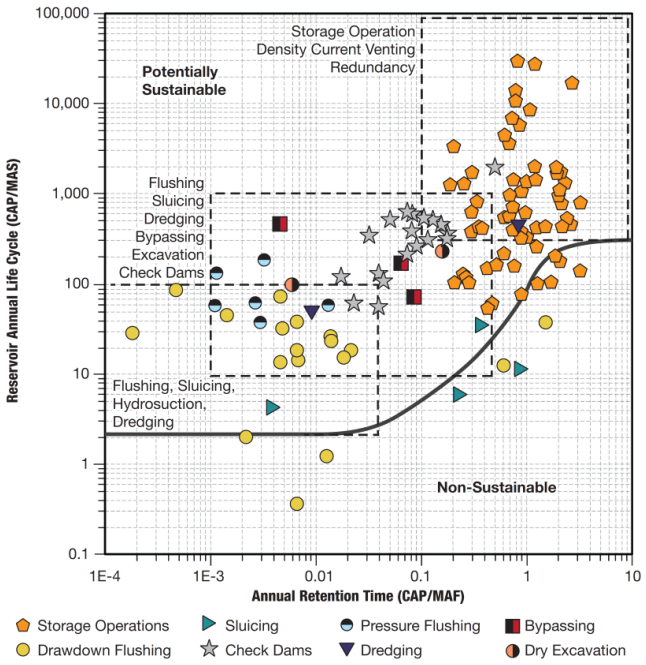

Figure 3 — Sediment Management Techniques Related to Reservoir Life and Retention Time*
The selection of the optimal sediment management technique for a reservoir can be estimated based on precedent experience and other factors, such as the ratio of reservoir volume to mean annual sediment inflow and retention time.
*Adapted[9]

Case studies

The case studies discussed below illustrate a range of sediment management concerns as well as strategies taken to mitigate them.

Aswan High Dam, Egypt

The 2,100- MW Aswan High Dam project on the Nile River in Egypt includes a 111 m high dam that impounds a 130 km^3 reservoir.[15] This dam has been controversial, largely due to concerns regarding sediment starvation of the Nile River Delta.[15]

Before construction of this dam, the Nile River transported an average of 100 x 106 tons/yr of sediment to the Nile River Delta in the Mediterranean Sea.[16] Today, with a trapping efficiency of 99%, little sediment reaches the delta.[15,16] While the live storage capacity of the Lake Nasser/Nubia reservoir upstream of Aswan High Dam is not expected to be compromised for another 300 to 400 years,[17] the adverse downstream impacts have been widely reported.[15] Erosion along the Mediterranean coast of Egypt has been ongoing for centuries, but the sediment trapping has combined with sea-level rise and other factors to exacerbate coastal erosion problems.[15]

Dez Dam, Iran

The 520 MW Dez hydroelectric project in southwestern Iran features a 203 m-high concrete arch dam. Reservoir sedimentation has caused the riverbed to rise by about 2 m per year, resulting in the loss of about 19% of reservoir storage during its 40 years of operation. As of 2016, the reservoir bed was now within 12 m of the power intakes, such that sediment may be drawn into the tunnels within a decade.

Sediment management strategies considered for the Dez project included watershed management, sediment flushing, tactical dredging near the power intakes, and heightening the dam. The optimal solution was determined to be sediment flushing, managed by means of powerhouse and spillway operation changes.

Another issue was the fact that sediments had risen above the low level outlets. As sluicing of the sediments through the Howell-Bunger valves introduced a risk of damage to the valves, a physical model was built to evaluate replacing these valves with radial sluice gates. Results showed that the downstream river reach could not tolerate the amount of scour associated with this modification, so the Howell-Bunger valves were redesigned with abrasion-resistant materials.

Three Gorges, China

In China, the extent of this issue has led to the development of innovations in sediment management.[14] Four main sediment management strategies have been adopted. They are: storing the clear and releasing the turbid, releasing turbidity currents, sediment flushing, and dredging.[19]

The 22,500 MW Three Gorges Project on the Yangtze River is the world's largest hydropower facility. The dead storage portion of the Three Gorges reservoir (17 billion m^3) is designed to be filled with sediment in about 120 to 150 years. The remaining 22 billion m^3 is to be retained indefinitely by flushing.[19] During the June to September flood season, when 50% to 60% of the annual runoff transports much of the sediments in Chinese rivers,[19] operators draw down the reservoir, retaining clearer water for the rest of the year. This strategy has been effective for reducing sediment impacts at both Three Gorges Dam and the Sanmenxia Reservoir, with a 400 MW powerhouse.[19]

Conclusions

The world's reservoirs are used for many purposes, among them to provide reliable water supply, hydropower and flood mitigation. Sustainable hydropower requires dealing with the important issue of reservoir sedimentation.

This article describes sedimentation processes, identifies key impacts of sedimentation on hydropower facilities and presents techniques that can be used to address these impacts. Sedimentation can affect hydropower production due to loss of reservoir storage and/or damage to the facility's mechanical components. Sediments deposited in reservoirs may affect the safety of dams and, without proper management, negatively impact the environment.

Methods of managing sediment fall under three general categories: those that divert sediment around or through the reservoir, those that remove deposited sediments, and those that minimize the amount of sediment reaching the facility in the first place. A variety of sediment management strategies have been used around the world, with many successful implementations documented.

This discussion highlights the need for appropriate sediment management at hydropower facilities and shows how this can be achieved through consideration of sediment concerns from the earliest design phase through to construction and operation.

Editor's Note: This is an abridged version of a much longer article on the topic. To read the article in its entirety, visit www.hydroworld.com/index/hydro-library.html.

Notes

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Ολοκληρωμένο σύστημα έγκαιρης ειδοποίησης σεισμών και εκτίμησης των αναμενόμενων ζημιών

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Πώς σε λίγα δευτερόλεπτα μπορούν να σωθούν πολλές ζωές και να περιορισθούν οι απώλειες

Από δημοσίευμα του ΑΠΕ-ΜΠΕ, την Τρίτη, 21 Φεβρουαρίου, 2017 (της Σμαρώς Αβραμίδου)

Πώς θα αντιδρούσαν οι πολίτες και το οργανωμένο κράτος στην Ελλάδα, εάν γνώριζαν ότι έχουν στη διάθεσή τους ελάχιστα δευτερόλεπτα, προκειμένου να αντιδράσουν σε επερχόμενο ισχυρό σεισμό; Μπορεί μία ολόκληρη πόλη να προγραμματιστεί σε ... «safe mode», τη στιγμή που τα σεισμικά κύματα θα φθάνουν σε κρίσιμες υποδομές της, όπως σχολεία, νοσοκομεία, μνημεία, δημόσια κτίρια και δίκτυα κοινής ωφέλειας; Και τι ασκήσεις κατά του πανικού συνίστανται στους πολίτες, τη στιγμή του συναγερμού; Η αξιοποίηση μίας τόσο κρίσιμης πληροφορίας, όπως η προειδοποίηση σεισμού, και μάλιστα με ακριβή προσέγγιση για το μέγεθος της δόνησης και τις αναμενόμενες ζημιές, δύναται να σώσει ανθρώπινες ζωές και να προλάβει καταστροφές. Πώς, όμως, γίνεται η διαχείρισή της;

Οι δύο πρώτες πιλοτικές εφαρμογές ενός ολοκληρωμένου συστήματος έγκαιρης προειδοποίησης σεισμών ξεκίνησαν στην Ελλάδα σχεδόν ταυτόχρονα στο πλαίσιο του ευρωπαϊκού ερευνητικού προγράμματος REAKT (http://www.reaktproject.eu/) και υλοποιήθηκαν για την πόλη της Θεσσαλονίκης από την Ερευνητική Μονάδα Εδαφοδυναμικής και Γεωτεχνικής Σεισμικής Μηχανικής του Αριστοτελείου Πανεπιστημίου Θεσσαλονίκης (ΑΠΘ) και για την περιοχή της γέφυρας Ρίου- Αντιρρίου από το Πανεπιστήμιο Πατρών.

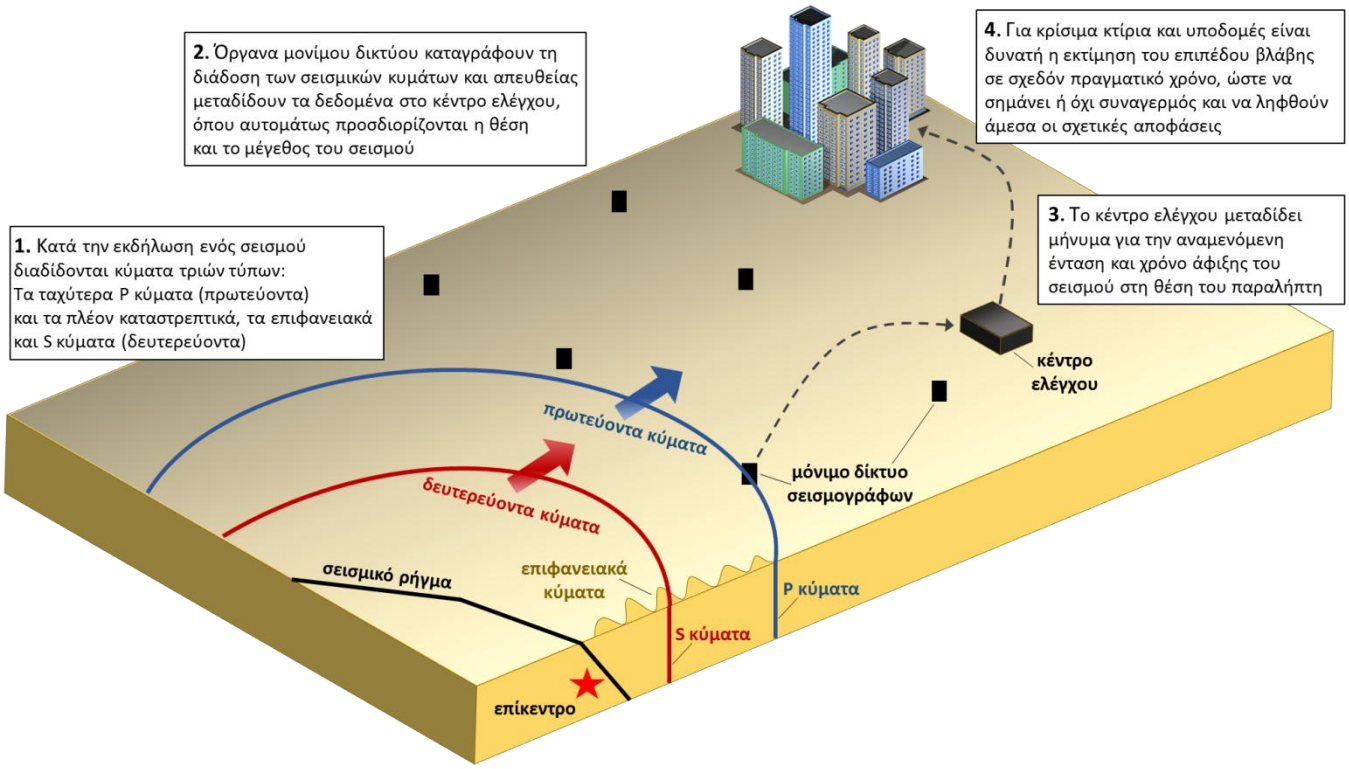
«Εκτίμηση σεισμού και απωλειών σε πραγματικό χρόνο!»

Τα συστήματα έγκαιρης προειδοποίησης σεισμών κατά κάποιον τρόπο «αισθάνονται» τις δονήσεις, που έρχονται.

Κατά την εκδήλωση ενός ισχυρού σεισμού διαδίδονται σεισμικά κύματα τριών κύριων τύπων: Τα ταχύτερα πρώτα κύματα «P» και τα πιο καταστρεπτικά, ήτοι τα «επιφανειακά» και τα «S» κύματα. Όργανα μονίμου δικτύου σε διάφορες θέσεις καταγράφουν τα «P» κύματα και απευθείας μεταδίδουν τα δεδομένα σε κέντρο ελέγχου, όπου αυτομάτως υπολογίζεται η αναμενόμενη ένταση του σεισμικού κραδασμού και δίνεται αντίστροφη μέτρηση μέχρι την άφιξη των εγκάρσιων και επιφανειακών καταστρεπτικών σεισμικών κυμάτων.

«Ένα ολοκληρωμένο σύστημα έγκαιρης προειδοποίησης έναντι επερχόμενου σεισμού συνοδεύεται, εκτός από την εκτίμηση του αναμενόμενου σεισμού (μέγεθος, απόσταση και χρόνος άφιξης σε μια θέση), με την άμεση και σε πραγματικό χρόνο εκτίμηση των αναμενόμενων ζημιών και απωλειών, κυρίως σε κρίσιμες υποδομές και σημαντικά κτίρια», λέει στο ΑΠΕ-ΜΠΕ ο καθηγητής Κυριαζής Πιτιλάκης, Διευθυντής της Ερευνητικής Μονάδας Εδαφοδυναμικής και Γεωτεχνικής Σεισμικής Μηχανικής του Τμήματος Πολιτικών Μηχανικών του ΑΠΘ.

Όπως διευκρινίζει, το πρώτο στάδιο της προειδοποίησης αφορά μια εκτίμηση του πόσο ισχυρός θα είναι ο κραδασμός του εδάφους από έναν συγκεκριμένο σεισμό, σε συγκεκριμένη απόσταση από το γενεσιουργό ρήγμα του σεισμού, ενώ το δεύτερο στάδιο αφορά την εξειδικευμένη εκτίμηση του επιπέδου βλαβών, που ενδέχεται να προκαλέσει ο κραδασμός σε ένα κτίριο ή μια υποδομή, αρκεί να έχει προηγηθεί κατάλληλη μελέτη του κτιρίου ή της υποδομής, για να είναι γνωστό πώς αποκρίνεται στον εκάστοτε εδαφικό κραδασμό.



Σχήμα 1. Σύστημα έγκαιρης ειδοποίησης για σεισμική δόνηση
(Εργαστηριακή Μονάδα Εδαφοδυναμικής και Γεωτεχνικής Σεισμικής Μηχανικής ΑΠΘ)

«Πόσες ζωές διαρκούν 10 δευτερόλεπτα;»

Εύλογο ερώτημα είναι ποιες διαδικασίες –αυτοματοποιημένες και μη- μπορεί να προβλεφθούν, όταν το περιθώριο αντίδρασης που εξασφαλίζει ένα σύστημα έγκαιρης ειδοποίησης σεισμών είναι της τάξης μερικών δευτερολέπτων... Για παράδειγμα, τι γίνεται, αν πρέπει να εκκενωθεί ένα νοσοκομείο; «Με κατάλληλη οργάνωση και ο χρόνος των μερικών δευτερολέπτων είναι ζωτικής σημασίας και μπορεί να σώσει ζωές και περιουσίες», διαβεβαιώνει ο κ. Πιτιλάκης και εξηγεί: «Για τα ελληνικά δεδομένα, που ο χρόνος αντίδρασης στην πλειοψηφία των "συναγερμών" θα είναι σχετικά μικρός -ίσως μικρότερος των 10 δευτερολέπτων- θα πρέπει να ληφθούν ειδικά μέτρα ατομικής προστασίας και να οργανωθεί κατάλληλα το σύστημα αντίδρασης του πληθυσμού και των αρμοδίων φορέων. Πολλά μπορούν να γίνουν σε 7-10 δευτερόλεπτα (χρόνος αντίδρασης για σεισμό αντίστοιχο με αυτόν του 1978 για τη Θεσσαλονίκη). Για παράδειγμα, να δοθεί εντολή από τον πύργο εναέριας κυκλοφορίας του αεροδρομίου "Μακεδονία" να καθυστερήσει μια προσγείωση, να ακινητοποιηθούν βαριά μηχανήματα στις προβλήτες του ΟΛΘ, να διακοπεί η παροχή φυσικού αερίου ή άλλων επικίνδυνων υλικών, ή η κίνηση συρμών του μετρό όταν με το καλό αρχίσει να λειτουργεί, να διακοπεί προσωρινά μια λεπτή χειρουργική επέμβαση στο ΑΧΕΠΑ, ακόμη και οι μαθητές ενός σχολείου να πάρουν κάποια πολύ βασικά μέτρα αυτοπροστασίας π.χ. «να μπουν κάτω από τα θρανία».

Ο καθηγητής διευκρινίζει, πάντως, ότι μέτρα όπως τα παραπάνω θα πρέπει να ληφθούν, όταν το επίπεδο συναγερμού και η τρωτότητα κάποιου κτιρίου είναι στο «κόκκινο». «Δε σημαίνει ότι για κάθε σεισμό θα πρέπει να γίνονται όλα αυτά. Και εδώ ακριβώς βρίσκεται η μεγάλη σημασία του συστήματος για το οποίο συζητάμε», τονίζει.

«Η βασική υποδομή για το σύστημα υπάρχει στην Ελλάδα»

Χρειάζεται η Ελλάδα ένα ολοκληρωμένο σύστημα έγκαιρης προειδοποίησης επερχόμενων σεισμών; Ο κ. Πιτιλάκης εκτιμά πως «θα ήταν χρήσιμο να υπάρχει σύστημα έγκαιρης ειδοποίησης που να καλύπτει τον ελλαδικό χώρο στο σύνολό του και κυρίως τις μεγάλες πόλεις και κρίσιμες υποδομές π.χ. το σύστημα παραγωγής και μεταφοράς ηλεκτρικής ενέργειας ή βιομηχανικές εγκαταστάσεις». Σημειώνει δε ως «πολύ θετικό σημείο», σε σχέση με το στάδιο εκτίμησης της σεισμικής δόνησης, ότι «η βασική υποδομή που απαιτείται για να στηρίξει ένα τέτοιο σύστημα υπάρχει ήδη και είναι τα μόνιμα δίκτυα σεισμογράφων και επιταχυνσιογράφων των διαφόρων ερευνητικών φορέων της χώρας».

«Αυτό που χρειάζεται είναι να γίνει μια συντονισμένη διάθεση ανθρώπινου δυναμικού από τα ερευνητικά κέντρα και τα Πανεπιστήμια, έτσι ώστε το σύστημα να λειτουργήσει, να βαθμονομηθεί, να ελεγχθεί η αξιοπιστία του και να προταθούν συγκεκριμένες αναβαθμίσεις/βελτιώσεις της υπάρχουσας υποδομής», επισημαίνει, ενώ για το στάδιο εκτίμησης των βλαβών διευκρινίζει πως «υπάρχει η σχετική τεχνογνωσία τουλάχιστον στο Εργαστήριο μας, όπως θα φανεί και στην συνέχεια, αλλά βρισκόμαστε ακόμη μακριά από μια συστηματική και καθολική εφαρμογή».

Σε ό,τι αφορά τη στάση των αρμόδιων φορέων της Πολιτείας έναντι των πολιτικών πρόληψης για τους σεισμούς ο καθηγητής επισημαίνει την ανάγκη για «μια ριζική αναμόρφωση αυτού που λέγεται πολιτική προστασία στην Ελλάδα, ώστε να εκσυγχρονισθεί και να αποκτήσει τις δυνατότητες που χρειάζεται για να επιτελέσει το σκοπό της αποτελεσματικά και για το καλό των πολιτών, της οικονομίας και της κοινωνίας γενικότερα».

«Από το ΑΧΕΠΑ ειδοποιήσεις για όλη τη Θεσσαλονίκη»

Το σύστημα έγκαιρης ειδοποίησης, με τη μορφή που εφαρμόζεται πιλοτικά στην Ερευνητική Μονάδα του ΑΠΘ, αφορά ολόκληρο το πολεοδομικό συγκρότημα της Θεσσαλονίκης, δηλαδή μπορεί εύκολα να παρέχει ειδοποίηση σε οποιοδήποτε σημείο της πόλης. Η πρώτη ολοκληρωμένη πιλοτική εφαρμογή του συστήματος άμεσης εκτίμησης των αναμενόμενων βλαβών από ισχυρή σεισμική δόνηση έγινε σε ένα από τα κτίρια (στη Νευρολογική Κλινική) του πανεπιστημιακού νοσοκομείου ΑΧΕΠΑ.

Η Δρ. Ζαφειρία Ρουμελιώτη, από την Ερευνητική Μονάδα Εδαφοδυναμικής και Γεωτεχνικής Σεισμικής Μηχανικής του ΑΠΘ εξηγεί στο ΑΠΕ-ΜΠΕ: «Κατά τη διάρκεια του ερευνητικού προγράμματος REAKT και σε συνεργασία με το ερευνητικό κέντρο GFZ Helmholtz-Zentrum Potsdam της Γερμανίας έγινε εγκατάσταση 13 επιταχυνσιογράφων σε διάφορα κομβικά σημεία και σε διαφορετικούς ορόφους του κτιρίου. Τα δεδομένα που συλλέχθηκαν χρησιμοποιήθηκαν για την εκτίμηση της σημερινής πραγματικής κατάστασης της τρωτότητας του κτιρίου, λαμβάνοντας υπόψη παράγοντες όπως π.χ. η γήρανση των υλικών κατασκευής του από την εποχή που κτίστηκε μέχρι σήμερα. Τα αποτελέσματα της ειδικής αυτής μελέτης μπορούν πλέον να συνδυαστούν με το σύστημα έγκαιρης ειδοποίησης και σε περίπτωση ισχυρού σεισμού να δοθεί άμεσα (εντός λίγων δευτερολέπτων από τη γένεση του σεισμού) μια εκτίμηση του επιπέδου βλαβών που είναι πιθανότερο να παρουσιάσει το συγκεκριμένο κτίριο».

«Το σχετικό δίκτυο βρίσκεται σε συνεχή λειτουργία παρά το ότι το ερευνητικό πρόγραμμα REAKT έχει πλέον ολοκληρωθεί και ο αριθμός των υπό παρακολούθηση κτιρίων εντός της Πανεπιστημιούπολης έχει ανέλθει πλέον σε 3 μέσω της υποστήριξης των ερευνητικών μας προσπαθειών από τον Ειδικό Λογαριασμό Κονδυλίων Έρευνας του ΑΠΘ», προσθέτει.

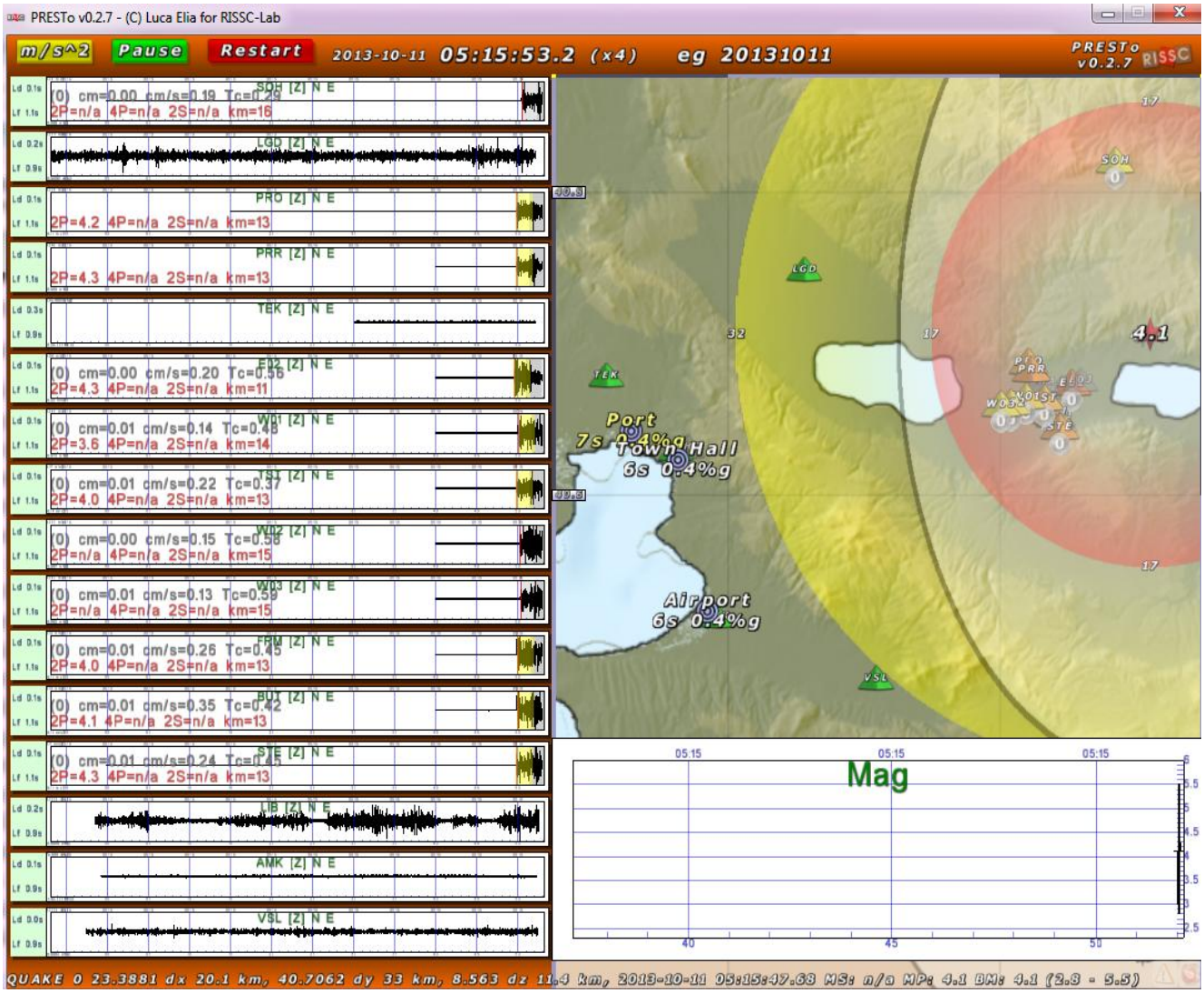
Σε ό,τι αφορά τον χρόνο αντίδρασης που εξασφαλίζει το εν λόγω σύστημα η κ. Ρουμελιώτη παρατηρεί: «Σε γενικές γραμμές, ο χρόνος αντίδρασης εξαρτάται από το πόσο μακριά από τη θέση ενδιαφέροντος βρίσκεται το επίκεντρο του σεισμού. Όσο πιο μακρινός είναι ο σεισμός, τόσο μεγαλύτερος είναι ο χρόνος αντίδρασης. Στην Ελλάδα, αν θυμηθούμε τους πιο φονικούς σεισμούς των τελευταίων δεκαετιών (Καλαμάτα 1986, Αίγιο 1995, Πάρνηθα 1999), εύκολα συμπεραίνουμε ότι το πρόβλημά μας δεν είναι τόσο οι μεγάλοι μακρινοί σεισμοί, αλλά οι μεσαίου μεγέθους, κοντινοί στις πόλεις μας σεισμοί. Σε αυτές τις περιπτώσεις ο χρόνος αντίδρασης είναι της τάξης των μερικών δευτερολέπτων. Ακόμη όμως και αυτός ο λιγοστός χρόνος είναι αρκετός για να γίνουν πολλά που θα σώσουν ζωές, θα περιορίσουν τις ζημιές και θα προστατεύσουν περιουσίες. Στην Κρήτη και τα νησιά του νοτίου Αιγαίου όπου σημαντικό ποσοστό των σεισμών είναι σεισμοί βάθους, ο χρόνος αντίδρασης μπορεί να φτάσει και τα 20-30 δευτερόλεπτα».

«Εκπαιδεύοντας τους πολίτες»

«Σε λίγα δευτερόλεπτα θα νιώσετε ισχυρά σεισμικά κύματα», προειδοποιεί μήνυμα από το σύστημα έγκαιρης ειδοποίησης σεισμών. «Θα πρέπει να δράσετε γρήγορα, για να προστατεύσετε τον εαυτό σας. Μείνετε ήρεμοι και φροντίστε για την ασφάλειά σας, ανάλογα με το περιβάλλον στο οποίο βρίσκεστε. Εάν βρίσκεστε στο σπίτι σας προστατεύστε το κεφάλι σας, μείνετε κάτω από ένα τραπέζι, μην τρέξετε έξω και μην ανησυχείτε για το φυσικό αέριο στην κουζίνα σας. Εάν βρίσκεστε σε δημόσιο κτίριο ακολουθήστε τις οδηγίες, που θα δώσουν οι υπεύθυνοι. Εάν οδηγείτε μην επιβραδύνετε απότομα, ενεργοποιήστε τα αλάρμ, για να προειδοποιήσετε τους υπόλοιπους οδηγούς και έπειτα κατεβάστε ταχύτητα ομαλά. Εάν περπατάτε στον δρόμο προσέξτε για το ενδεχόμενο κατάρρευσης τμημάτων κτιρίων. Αν βρίσκεστε μέσα σε λεωφορείο ή τρένο κρατηθείτε γερά από κάποια χειρολαβή. Αν βρίσκεστε στο ασανσέρ κατεβείτε στον πρώτο όροφο που μπορείτε να σταματήσετε. Αν είστε σε βουνό προσέξτε για κατολισθήσεις».

Ένας γενικός συναγερμός, ή ένα προσωπικό μήνυμα στο κινητό πως σε διάστημα λίγων δευτερολέπτων θα σημειωθεί ένας ισχυρός σεισμός, είναι μία πληροφορία όχι εύκολα δια-

χειρίσιμη από τους ανθρώπους που τη λαμβάνουν. Στην Ιαπωνία και σε άλλες χώρες, όπου πολίτες και φορείς είναι εξοικειωμένοι με τις συχνές και κατά καιρούς ισχυρές σεισμικές δονήσεις, τα συστήματα έγκαιρης προειδοποίησης αποτελούν πολύτιμα εργαλεία για την προστασία των ανθρώπων και κρίσιμων υποδομών και δικτύων. Η εκπαίδευση των χρηστών των συστημάτων έγκαιρης προειδοποίησης είναι διαρκής, με απλές οδηγίες, όπως αυτές παραπάνω που προέρχονται από ενημερωτικό φυλλάδιο της Ιαπωνικής Μετεωρολογικής Υπηρεσίας (www.jma.go.jp/jma/en/Activities/eew.html).



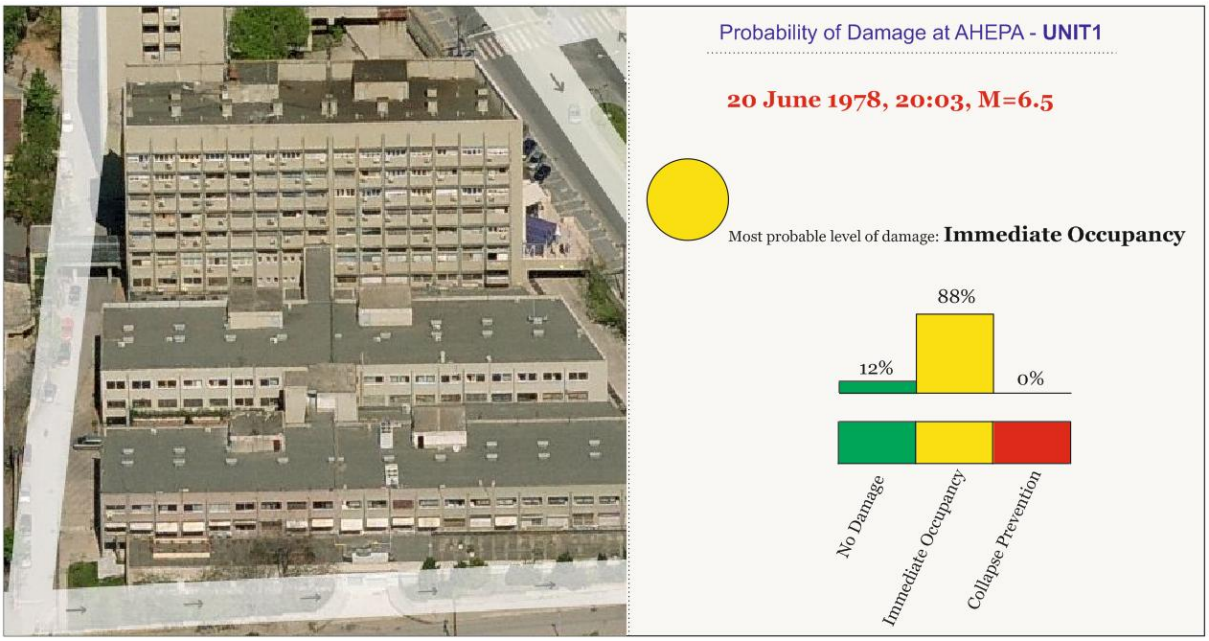
Σχήμα 2. Στιγμιότυπο του γραφικού αποτελέσματος του συστήματος έγκαιρης ειδοποίησης για σεισμική δόνηση (Λογισμικό PRESTo, Satriano et al. 2010; Zollo et al. 2010). Με σύμβολο αστεριού σημειώνεται η θέση του επικέντρου του σεισμού μεγέθους 4.1, βόρεια της λίμνης Βόλβης. Με κίτρινο χρώμα συμβολίζεται το μέτωπο των ταχύτερων σεισμικών P κυμάτων (επιμήκων), τα οποία δίνουν την πληροφορία για τον υπολογισμό του επικέντρου και του μεγέθους του σεισμού. Με κόκκινο χρώμα σημειώνεται το μέτωπο των εγκάρσιων S κυμάτων, τα οποία είναι κατά κανόνα τα πιο καταστρεπτικά. Σε διάφορες θέσεις στην περιοχή της Θεσσαλονίκης (π.χ. στο αεροδρόμιο - Airport) υπολογίζεται η αναμενόμενη ένταση του σεισμικού κραδασμού και δίνεται αντίστροφη μέτρηση μέχρι την άφιξη των εγκάρσιων κυμάτων. Στο συγκεκριμένο παράδειγμα, που αφορά σεισμό που εκδηλώθηκε στις 10 Οκτωβρίου 2013 και έγινε ευρύτατα αισθητός σε ολόκληρο σχεδόν το πολεοδομικό συγκρότημα της Θεσσαλονίκης, ο χρόνος που απομένει μέχρι την άφιξη του κόκκινου μετώπου είναι 6 δευτερόλεπτα για τις θέσεις του αεροδρομίου και του Δημαρχείου και 7 δευτερόλεπτα για τη θέση του λιμανιού (Roumelioti et al. 2014).

Όταν φτάνει μία έγκαιρη ειδοποίηση σεισμού και εκτιμάται μία βλάβη σε σιδηροδρομική γραμμή το κέντρο ελέγχου κίνησης μέσω ασύρματου δικτύου υποχρεώνει αυτόματα όλα τα τρένα να σταματήσουν αμέσως λόγω κινδύνου. Σε ένα εργοτάξιο, όταν οι εργάτες ειδοποιούνται για τα ισχυρά σεισμικά κύματα που έρχονται, απομακρύνονται από τους γερανούς και καταφεύγουν σε ασφαλές μέρος, ενώ οι χειριστές των γερανών κατεβάζουν τα αντικείμενα. Σε ακτινολογικές εγκαταστάσεις ανοίγουν αυτόματα όλες οι πόρτες για να δώσουν στους ασθενείς τη δυνατότητα να απομακρυνθούν

«Στην Καλιφόρνια, όπου διαφορετικά συστήματα έγκαιρης ειδοποίησης δοκιμάζονται συστηματικά τα τελευταία χρόνια, ψηφίστηκε το 2013 νόμος, ο οποίος καθιστά υποχρεωτική την ύπαρξη τέτοιου συστήματος. Εκεί το σύστημα δεν απευθύνεται στους πολίτες, αλλά στους υπεύθυνους πολιτικής προστασίας και σε διαχειριστές κρίσιμων υποδομών. Σε άλλες χώρες όπως η Ιαπωνία και το Μεξικό, το σύστημα απευθύνεται άμεσα και στους πολίτες», αναφέρει ο κ. Πιτιλάκης, ενώ η κ. Ρουμελιώτη προσθέτει:

«Σε χώρες όπου συστήματα έγκαιρης ειδοποίησης απευθύνονται άμεσα στους πολίτες έχει διαπιστωθεί ο πανικός που ένας συναγερμός μπορεί να προκαλέσει. Το μόνο σχέδιο

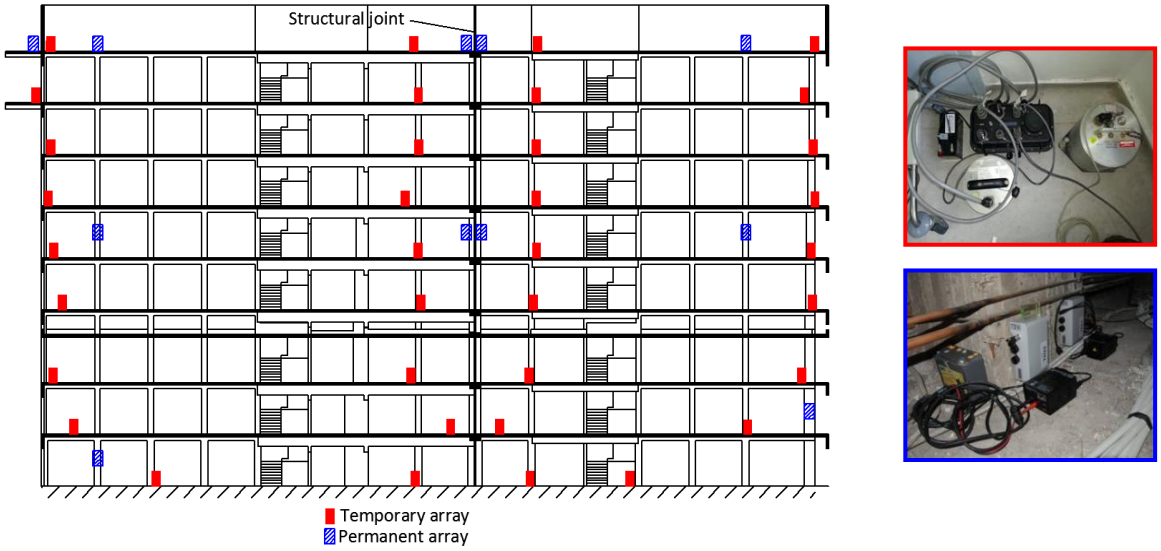
εκπαίδευσης σε αυτές τις περιπτώσεις δεν μπορεί να είναι άλλο από τη διαρκή ενημέρωση των πολιτών ως προς το πώς μπορούν να διαχειριστούν την πληροφορία που τους παρέχεται. Ακόμα και οι πιο έμπειροι στη λήψη τέτοιων μηνυμάτων Ιάπωνες, μετά το σεισμό M9.0 του Tohoku δήλωσαν σε ποσοστό >50% ότι δεν μπόρεσαν να αντιδράσουν σωστά στον συναγερμό, είτε επειδή πανικοβλήθηκαν, είτε επειδή δεν πρόλαβαν. Ωστόσο, στην πλειοψηφία τους εξακολουθούν να θέλουν να λαμβάνουν μηνύματα έγκαιρης ειδοποίησης (π.χ. στο κινητό τους ή στα ΜΜΕ) έστω και για να μπορούν να προετοιμαστούν ψυχολογικά για την επερχόμενη δόνηση».



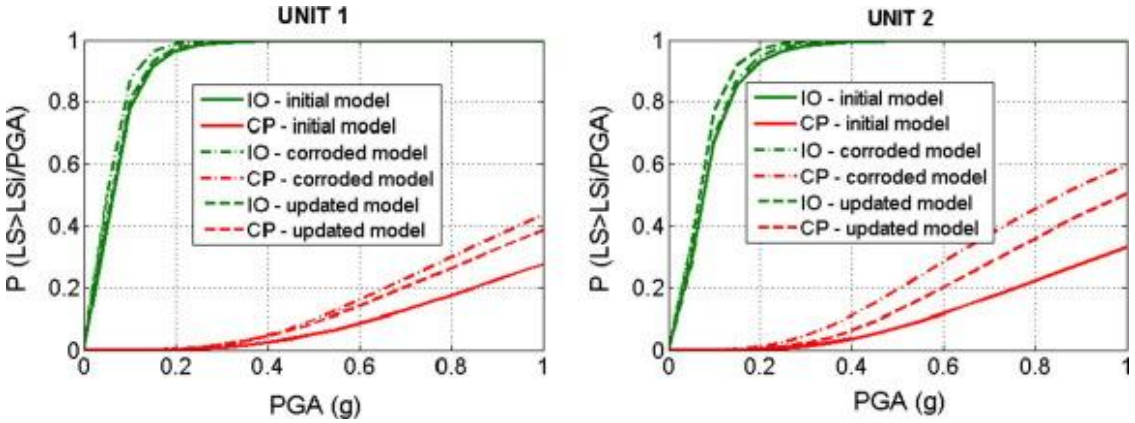
Σχήμα 3. Υπολογισμός σε πραγματικό χρόνο του πιθανότερου βαθμού βλάβης για ένα κτίριο νοσοκομείου (αναπαραγωγή δεδομένων από σεισμικά κύματα που θα προκαλούσε ο σεισμός M6.5 του 1978).

Όπως φαίνεται το συγκεκριμένο κτίριο του νοσοκομείου Α-ΧΕΠΑ για το σεισμό αυτό μεγέθους M6.5 σε απόσταση 25km περίπου θα έχει σχεδόν 90% πιθανότητα να βρίσκεται στην κίτρινη ζώνη ζημιών.

Στα σχήματα που ακολουθούν δίδεται σχηματικά η ενοργάνωση του κτιρίου και οι εκτιμηθείσες καμπύλες τρωτότητας με βάση τις οποίες εξήχθει το συμπέρασμα του Σχήματος 3.



4. Ενόργανη παρακολούθηση κτιρίου στο νοσκομείο ΑΧΕΠΑ (συνεργασία Ερευνητικής Μονάδας Εδαφοδυναμικής και Γεωτεχνικής Σεισμικής Μηχανικής ΑΠΘ-με το German Research Centre for Geosciences). Με μπλε χρώμα σημειώνονται οι θέσεις των μόνιμων οργάνων καταγραφής μετακινήσεων (σεισμόμετρα) βάσει των οποίων υπολογίζεται ο βαθμός βλάβης που αναμένεται να παρουσιάσει το κτίριο αμέσως μετά το σεισμό. Με κόκκινο χρώμα σημειώνονται οι θέσεις αντίστοιχων προσωρινών οργάνων που χρησιμοποιήθηκαν για τον έλεγχο της υφιστάμενης δομικής κατάστασης του κτιρίου.



Σχήμα 5. Καμπύλες τρωτότητας για κτιριακές μονάδες του νοσοκομείου ΑΧΕΠΑ στη Θεσσαλονίκη. Σύγκριση για το αρχικό προσομοίωμα (as built model), το αναθεωρημένο με βάση ενόργανες μετρήσεις (ambient noise measurements) για τον προσδιορισμό των δυναμικών χαρακτηριστικών του κτιρίου σήμερα, και το προσομοίωμα με την επίδραση της διάβρωσης λόγω παλαιότητας (45 χρόνια), για δύο στάθμες βλάβης (immediate occupanc: IO) και collapse prevention: CP) (Karapetrou et al. 2016).

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Lime-Stabilized Backfill in MSE Retaining Structures

Giulia Lugli and Sachin Mandavkar

Soil can be stabilized by using a wide range of materials, such as cement, lime, and fly ash. When lime and water are mixed with a clay soil, modification of the soil properties and stabilization reactions begin. In highly alkaline environments (pH >12 for a short period of time), this can cause corrosion of steel elements in an engineered reinforcement system, such as with mechanically stabilized earth walls. LLDPE-coated, planar, high tenacity polyester strips used in the reinforcement of concrete facing panels of an MSE wall in these environments provide a strong solution.

Properly using this approach requires an understanding of the soil parameters, lime percentage in the reinforced backfill, the behavior and the durability of the LLDPE coated reinforcement, and the installation procedure.

IMPROVING BACKFILL MATERIALS

The interaction between backfill material and reinforcing elements plays a significant role in the performance of MSE walls. The backfill is usually reasonably free from organic or other deleterious materials and conforms to applicable gradation requirements. Where its suitable to a design, the use of onsite material may be preferred in order to reduce the overall cost of a structure.

Clay of moderate to high plasticity or fine-grained soils for backfill require the improvement of the soil parameters. This process will reduce settlement, increase bearing resistance, and improve the overall stability of the structure. The type of soil improvement (stabilization) is classified based upon structural performance criteria in three main categories:

- Unbound materials – Resistance is mainly provided by cohesion and friction between the particles and no significant tensile strength is shown. Deformation is given by shear, densification and breakdown of particles

- Modified materials – A small amount of a stabilizing agent is added to an unbound material to increase the strength or reduce the moisture or frost susceptibility without increasing the stiffness

- Bound materials – A stabilizing agent is added to an unbound material in order to obtain better structural performances. The resulting material has a new developed shear strength given by particle interlock, chemical bonding and cohesion, and significant tensile strength. Deformations are due to cracking through shrinkage, fatigue, and overstressing.

The choice of the stabilizer may be determined factors such as gradation, plasticity index, climate, availability and cost of the material, construction equipment availability, experience of site labor, etc. Particle size distribution and Atterberg limits are often considered in order to get a preliminary idea of the best type of stabilization. All materials must be properly assessed and thoroughly evaluated in a certified laboratory before any fieldwork starts, in order to estimate their uniformity and quality.

LIME-STABILIZED BACKFILL

Lime treatment can chemically transform unstable soils into exploitable materials, improving both workability and strength. Small amounts can be used to dry and modify soils to create temporary roads and working platforms. Larger amounts can result in a permanent structural stabilization of soils. Lime can stabilize soils under the form of quicklime (calcium oxide – CaO), hydrated lime (calcium hydroxide – $Ca[OH]_2$), or lime slurry. Quicklime is manufactured through the chemical transformation of calcium carbonate (limestone – $CaCO_3$) into calcium oxide. Hydrated lime is produced by making quicklime chemically react with water.

When lime and water are mixed with a clay soil, these chemical reactions occur almost immediately:

Soil drying: quicklime immediately chemically combines with water and starts releasing heat. The water present in the soil reacts, and the generated heat evaporates some additional moisture leading to soil drying. The resulting hydrated lime will then react with clay particles reducing the soil capacity to hold water (additional drying). Drying occurs quickly, within a matter of hours, enabling the contractor to compact the soil much more rapidly than by waiting for the soil to dry through natural evaporation. In case of hydrated lime or hydrated lime slurry, only drying due to reaction with clay occurs.

Modification: After the initial phase, the calcium ions (Ca++) from hydrated lime move onto the clay particles displacing water and other ions. The PI of the soil dramatically decreases as a consequence in a process called "flocculation and agglomeration" that occurs in a matter of hours, and so does its tendency to swell and shrink. The soil becomes easier to work and compact.

Stabilization: Long-term strengthening is due to pozzolanic reactions that occurs in the highly alkaline environment (pH >12 for a short period of time), which leads to the breaking down of the clay particles, and allows the formation of calcium silicates and aluminates that form the matrix that contributes to the strength of lime-stabilized soil layers. The soil is thus transformed: the clay surface mineralogy is altered producing a hard, relatively impermeable layer with significant load bearing capacity. The process begins within hours but is relatively slow and can last for years. Warm weather is generally required for the process: the air temperature should be approximately 5 °C rising during the reaction. Colder weather conditions are possible if lime reaction is used for drying wet soil. Frozen soil condition should be avoided or treated properly following specific procedure.

In general, fine-grained clay soils (with a minimum of 25% passing the #200 sieve and a plasticity index greater than 10) are considered to be suitable for lime stabilization. Clay components in the soil are required in order to react with lime, as lime stabilization technique requires a soil that contains natural pozzolan.

GEOSTRIP REINFORCEMENTS IN HIGHLY ALKALINE ENVIRONMENTS

The choice of the proper reinforcement is fundamental in the design with lime-stabilized soil. If the corrosion penetration occurs, the design life of the structure may reduce considerably. The Maccaferri MacRes® MSE System combines the precast facing panels with high tenacity polyester strips co-extruded with LLDPE (Linear Low Density Polyethylene).

Resistance to chemical degradation of the polyester strips is generally a function of the following index properties:

- PET Molecular Weight (Mn)

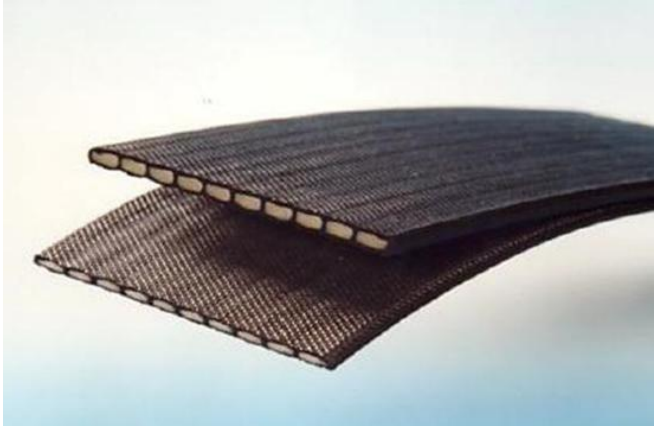
- PET Carboxyl End Group Content (CEG)

- PET retained strength after 500 hrs in weatherometer

Biological degradation is also function of the Molecular Weight. As per FHWA–NHI–00-044 polymers with high mo-

lecular weight are less susceptible to the enzymatic degradation.

The polyethylene sheath represents an additional protection to the polyester yarns from the aggressive backfill materials. In general, the most chemically aggressive backfill materials are usually of fine particle sizes (e.g., clayey sand or sandy clay soils) which may cause little or no damage to the polyethylene sheath. The durability reduction factor values, RF_D, depend on the soil pH and on the design temperature of the soil. Usually RF_D is provided for pH range between 4.5 and 9 and between 9 and 11.



At pH levels greater than 10, and over long-term durations at pH >9, the surface of polyester fibers is progressively eroded by "external hydrolysis". This leads directly to a loss of strength and occurs in parallel with internal hydrolysis. For this reason, there are restrictions on the use of polyester (PET) in environments of pH 9 and above, although these effects have so far been observed at higher pH values, which occur very rarely in natural soils.

Greenwood's research (2007) indicated a high level of chemical resistance in geostrips due to the presence of the protective sheath. Still, where the pH is likely to exceed 9.0 in the long term, an assessment should be performed for the exact environment (pH, type of metallic ion, temperature).

PROJECT: MSE WALL WITH LIME-STABILIZED BACKFILL

During the construction of a new ring road system in Tangenziale di Forlí, Italy, about 4,700 m^2 of retaining walls with concrete facing panels were realized over a mainly cohesive alluvial soil with compressible sandy silt and clay with sand and gravel stretches. These soils were subject to significant geotechnical problems, especially related to both differential and total settlements. The MSE structures, which included nine wing walls, were realized with polyester strips as the reinforcing elements and square 1.5 x 1.5 m concrete facing panels.

The reinforcing strips used for this project varied from a minimum ultimate tensile strength of 27 kN to a maximum of 36 kN. The maximum height of the MSE wall was about 8.5 m and the vertical spacing between each reinforcement layer was 0.75 m.

The soil used for the construction of the embankment originally came from the excavation of a subway belonging to the same lot. This was determined to be the most suitable choice from cost and sustainability perspectives. However, the silty clay nature of the material was not truly suitable for road construction.

A soil stabilization technique had to be used to enhance the soils characteristics.

After careful design and testing, lime stabilization was adopted. (Lime was the 2.5% of the soil weight.) The soil-lime mix, respecting the planned amounts of lime, took place outside of the field test, and the treated soil was transferred and compacted on site. The resulting material had an improved shear strength—provided by particle interlock, chemical bonding, and cohesion—and significant tensile strength.

Typical values for mechanical resistance of lime stabilized soils are c'=25 kPa and f'=30 °.

For this project, the mechanical resistance values were obtained by laboratory testing to characterize the lime-stabilized soils cohesion, unit weight and friction angle. In this case a cohesion c' equal to 0 was assumed, per client request.

Giulia Lugli is EMEA Region, USA & Canada Maccaferri Vertical Walls Sector Technical Specialist and Sachin Mandavkar a Technical Manager for Maccaferri Inc. (USA), www.maccaferri.com

A longer version of this article was published in the GeoAmericas 2016 proceedings along with 200 other geosynthetics technical papers and lectures. The proceedings are available for purchase and download at www.geoamericas2016.org.

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(Chris Kelsey / geosynthetica.net, February 9, 2017, http://www.geosynthetica.net/lime-stabilized-backfill-mse-walls-geostrips)

ΝΕΑ ΑΠΟ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

Dear Members of ISSMGE,
Dear Colleagues,

I am most happy to announce the launching of the ISSMGE Global Survey on the State of the Art (SoA) and the State of Practice (SoP) in geotechnical engineering. Allow me to insist strongly that you all take part in the survey.

The survey will officially be launched on the 10th of March 2017. The link to the survey is: https://www.surveymonkey.com/r/CAPG_SoA_SoP_survey

Please, note that the survey will be running until the 30th of April 2017.

As you know, the ISSMGE is committed to working closely with both the academia and the practical world of the geotechnical engineering profession. I consider that one of its main goals is thus to bridge the gap between the state of the art and the state of practice. In other words, the ISSMGE should help transferring to practice more results from the academic research and, reciprocally, help better feeding the academic research with the needs of practice. The ISSMGE Technical Committees (TCs) are, obviously, the main tool for achieving this important goal.

The intent of this survey is to identify important areas for improvement as well as… recognising achievements our profession has made! This is why it is very important that as many geotechnical engineers as possible take part in the survey and contribute to the best possible understanding of the situation in our great profession.

This survey is the result of two years of planning and consultation. It is a joint product of the Corporate Associates Presidential Group (CAPG) and the Technical Oversight Committee (TOC), which are two of the Board Level Committees of the ISSMGE. I would like to express here my gratitude to the CAPG, chaired by Sukumar Pathmanandavel, to the TOC, chaired by Pierre Delage, as well as to the Officers of all the TCs for their hard work and commitment to the launching of the survey.

The survey is launched well ahead of the 19th International Conference to be held in Seoul in September 2017. The idea is that the results from this survey will be presented and discussed at the Seoul conference. Your views will thus provide valuable input to this very prestigious world conference!

The survey is designed to be completed within a relatively short time frame, which can be as short as 15 minutes. You are not obliged to answer all the questions. Just answer those which you feel are interesting. You can of course take more time and contribute more extensively. The CAPG and the TOC, together with the TCs, will value each and every response, short or long. Please, also note that it is best to complete this survey in one sitting as the survey mechanism does not cater to saving your responses.

We are looking forward to receiving your survey responses. I thank you very much In the name of those who planned and designed the survey, as well as in the name of the geotechnical community represented by the ISSMGE!

Roger Frank, ISSMGE President

27th February 2017

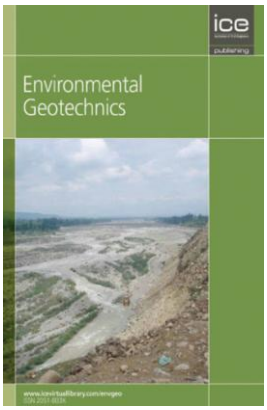
ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

Shallow geothermal energy for buildings and infrastructure

Dear Colleague,

You are warmly invited to propose a paper for the themed issue of **Environmental Geotechnics** on *Shallow geothermal energy for buildings and infrastructure*, edited by Marco Barla (Politecnico di Torino, Italy), Mroueh Hussein (Lille University, France), Fleur Loveridge (Leeds University, UK) and Ana Vieira (Laboratorio Nacional de Engenharia Civil, Portugal). Please submit an abstract of the article you would like to write by **20th August 2017**.



In recent years, the growing need for renewable energy sources has led to the increased interest in shallow geothermal applications for the heating and/or cooling of buildings. The integration of heat exchangers in the elements of the structure the interface with the ground, such as foundations, tunnels and diaphragm walls, is particularly attractive due to the inherent cost savings involved in combining a required structural component with the harvesting of geothermal energy. Thermoactive geostructures present the additional benefit of relying on localised resources (the ground) and, therefore, do not need additional infrastructural investments. By providing an alternative to fossil fuels and reducing peak demand from the grid, they also provide an attractive tool towards energy independence and distributed generation with no adverse impact on the environment. However, the widespread application of this sustainable technology is currently hindered by the large disparity in development and uneven regulatory frameworks worldwide. The guest editors believe that up-to-date and reliable information from leading researchers and practitioners in this field would bring increased confidence and visibility to these applications. This themed issue will collect state-of-the-art knowledge on the topic, covering technical aspects, and benchmarking examples, guidelines and standards.

Please use the form (submit) to submit an abstract (approximately 200 words) outlining your proposed contribution. The deadline for abstract submissions is 31 July 2017.

The Editorial Panel will then consider all proposals and invite full papers from selected authors. The deadline for full papers is 15 December 2017. If you have any queries, please contact sam.hall@icepublishing.com.

ICTUS17 The 2017 International Conference on Tunnels and Underground Spaces, 28 August 2017 - 1 September 2017, Seoul, Korea, www.i-asem.org/new_conf/asem17.htm

International Symposium on Coupled Phenomena in Environmental Geotechnics, 6-8 September 2017, Leeds, United Kingdom, http://tinyurl.com/cpeg2017

Brownfield Risk Assessment & Remediation, 13-14 September 2017, London, United Kingdom, https://brownfieldbriefing.com/risk-remediation-2017?ls=lnk

19th International Conference on Soil Mechanics and Geotechnical Engineering, 17 - 22 September 2017, Seoul, Korea, www.icsmge2017.org

AGS Association of Geotechnical & Geoenvironmental Specialists

AGS GEOTECHNICAL DATA CONFERENCE 2017
Best Practice, Challenges and Future
20th September 2017, Birmingham, U.K.
ags@ags.org.uk

The Association of Geotechnical and Geoenvironmental Specialists are pleased to announce that **The Geotechnical Data Conference** is returning to the National Motorcycle Museum in Birmingham on **Wednesday 20th September.**

This specialist full day seminar will be divided into four sessions and will focus on the role of geotechnical and geoenvironmental data management within digital engineering and BIM, whilst celebrating 25 years of AGS Data Transfer Format. Details of this year's speakers can be viewed below:

SESSION 1: Client View

- Long Term Monitoring for Rail Projects
- Improving Geotechnical Information - Results from an HE Study
- Experiences in adopting AGS and Future Requirements

SESSION 2: International

- Out of Adversity Can Come Good Things or A Tale of Two Corollaries
- Very Large Data Sets – Challenges, Insights and Opportunities

SESSION 3: Case Studies

- Consultancy Led Ground Investigation Contracting on Large Infrastructure Projects
- Transpennine Route Upgrade – Value Engineering through Geotechnical Data Management
- Moorside Site Characterisation Project
- Geotechnical Data Management for Thames Tideway
- Reducing the Amount of Non-Digital Data Recording/Collection/Scheduling
- Information Modelling Workflows for Using Geotechnical Data in Civil Engineering
- Digital Data Journey Refinement

SESSION 4: BIM

- BuildingSMART and the Future Role of Geotechnical Data

in the BIM process
- Outcomes from the BIM for the Subsurface project
- National Geoscience Data Centre: Building an Open National AGS Data Store

Full information will be made available on the AGS website in due course.

POSTAL ADDRESS: Association of Geotechnical and Geoenvironmental Specialists, Devonshire House Business Centre, 29-31 Elmfield Road, Bromley, Kent BR1 1LT

IICTG 2017 Conference
"ICT — Past and Future"
September 26÷28, 2017, Minneapolis, Minnesota, USA
www.iictg.org/2017-conference

The International Intelligent Construction Technologies Group (IICTG) is a source for knowledge and information on intelligent construction technologies for public agencies, contractors, consultants, academia, and other relevant industries.

IICTG provides a forum for the dissemination of knowledge concerning the collection, analysis, and application of information relating to intelligent construction technologies (ICT).

ICT consists of real time quality monitoring and process control during construction of foundation and pavements for highways, airports, railroads, dams, cities, and ports. ICT involves construction equipment technologies such as pavers, rollers, and other devices.

ICT also makes use state-of-the-art technologies such as Global Navigation Satellite System (GNSS), automated testing/monitoring, 3D designs/modeling, automated machine guidance (AMG), Cloud computing, Civil Integrated Management (CIM) and Building Information Modeling (BIM), etc. The goals of ICT are to improve quality control and acceptance of constructions as well as reducing life-cycle cost of the above mentioned assets.

The initial scope of IICTG would focus on the specific technologies such as Intelligent Compaction (IC) and paver-mounted thermal profiling (PMTP).

The scope is expected to expand to other areas such as 3D designs/modeling, AMG, CIM and BIM. It is anticipated that the IITCG will evolve in the future along with technology advancements and changes in the ways construction are being done.

The IICTG 2017 conference will be held at the Renaissance Minneapolis Hotel, The Depot, in Minneapolis, Minnesota, USA from September 26 to 28, 2017.

Theme and Topics

The theme of the IICTG 2017 conference is:

"ICT (Intelligent Construction Technologies) — Past and Future"

This conference will cover the history and future development of intelligent construction technologies (ICT). Other main topics will include intelligent compaction (IC), Paver-Mounted Thermal Profiling (PMTP) and data management , etc.

IICTG encourages you to share the latest-&-pertinent topics in presentation form on the following topics:

- Integration of Intelligent Construction Technologies (ICT)
- Research and Implementation on Intelligent Compaction (IC) Equipment and Systems
- Research and Implementation on Paver-mounted Thermal Profiling (PMTP) Equipment and Systems
- Positioning Systems and Automated Machine Guidance (AMG) for Intelligent Construction
- Data Analysis and Reporting of Intelligent Construction Data
- Cloud Computing and Data Management for Intelligent Construction
- Standardization of IC Measurements, Data Exchanges, and Storage
- IC Specifications and Case Studies – Lessons Learn

AfriRock 2017, 1st African Regional Rock Mechanics Symposium, 2 – 7 October 2017, Cape Town, South Africa, www.saimm.co.za/saimm-events/upcoming-events/afrirock-2017

Geotechnique Symposium in Print 2017 Tunnelling in the Urban Environment, http://www.icevirtuallibrary.com/pb-assets/Call%20for%20Papers/Geo-Symposium-CFA-AW.pdf

HYDRO 2017 Shaping the Future of Hydropower, 9-11 October 2017, Seville, Spain, hydro2017@hydropower-dams.com

GeoAfrica 2017 3rd African Regional Conference on Geosynthetics, 9 – 13 October 2017, Morocco, http://geoafrica2017.com

3ο Πανελλήνιο Συνέδριο Φραγμάτων και Ταμιευτήρων - Διαχείριση Έργων και Προοπτικές Ανάπτυξης, 12 - 14 Οκτωβρίου 2017, Αθήνα, www.fragmata2017.gr

4th International Conference on Long-Term Behaviour and Environmentally Friendly Rehabilitation Technologies of Dams, 17-19 October 2017, Tehran, Iran, www.ltbd2017.ir/en

The 15th International Conference of International Association for Computer Methods and Advances in Geomechanics, 19-23 October 2017, Wuhan, Hubei Province, China, www.15iacmag.org

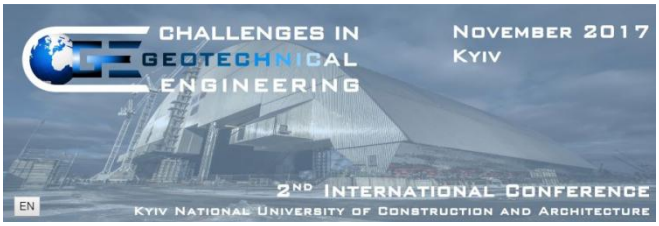
XIII International Conference "Underground Infrastructure of Urban Areas 2017", 24-26 October 2017, Wroclaw, Poland, http://uiua.pwr.edu.pl/?lang=en

ISAUG 2017 2nd International Symposium on Asia Urban GeoEngineering, 24-27 November 2017, Changsha, China, www.isaug2017.org

SIFRMEG 2017 Shaoxing International Forum on Rock Mechanics and Engineering Geology, October 28-29, 2017, http://forum.hmkj.com.cn/index.php/Index/show/tid/20

11ο Συνέδριο «Ελληνική Γλώσσα και Ορολογία», 9–11 Νοεμβρίου 2017, Αθήνα, www.eleto.gr/gr/Conference11.html

PARIS 2017 AFTES International Congress "The value is Underground", 13-16 November 2017, Paris, France, www.aftes2017.com



2nd International Conference
"Challenges in Geotechnical Engineering" 2017
20-23 November 2017, Kyiv, Ukraine
www.cgeconf.com/en

Kyiv National University of Construction and Architecture (KNUCA) and the University of Zielona Gora (Poland) in cooperation with the Ukrainian Society for Soil Mechanics, Geotechnics and Foundation Engineering (UkrSSMGFE) takes a great pleasure to invite you to participate in the Second International Conference "Challenges in Geotechnical Engineering" CGE-2017. The conference is organized under the framework of the international scientific cooperation between Ukraine and Poland. It further expands more than 70 years of experience in conducting scientific conferences by KNUCA and a 40-year tradition of organising conferences on engineering geology by the University of Zielona Gora.

The conference aims to improve scientific and technical levels in solving geotechnical problems. The conference program highlights the most relevant and promising areas of solving geotechnical issues, including:

- Numerical simulation.
- Analysis of the interactions of the elements in the "soil - foundation - structure" system.
- Construction of high-rise buildings and deep foundation pits.
- Ensuring slope stability.
- Construction in the seismically dangerous areas or under dynamic loads.
- Installation of foundations under difficult geological conditions.
- Areas with a complex geological and glacitectonic structures
- Modern methods of soil research and other geotechnical and related issues.

Sections

1. Soil-Structure Interaction and Retaining Walls
2. Slope Stability in Engineering Practice
3. Earthquake Engineering and Associated problems
4. Numerical Methods in Geomechanics
5. Foundation Engineering for Difficult Soft Soil Conditions
6. Ground Property Characterization
7. Deep foundations
8. Areas with a complex geological and glacitectonic structures
9. Safety and Serviceability in Geotechnical Design
10. Engineering Practice of Risk Assessment and Management
11. Preservation of Historic Sites
12. Transportation Geotechnics

Information

Ukraine, 03680, Kyiv, 31 ave. Povitroflotsky
Tel./Fax: +38(044) 245-41-24, mob.: +38(097) 381-1265;
e-mail: info@cgeconf.com
Website: www.cgeconf.com

2nd International Symposium on
Asia Urban GeoEngineering
24-27 November 2017, Changsha, China
hwww.isaug2017.org

You are warmly invited to attend the 2nd International Symposium on Asia Urban GeoEngineering on November 24-27, 2017 in Changsha, a historical and modern city in Hunan, China. The aim of this symposium is to share ideas and experiences about urban geoengineering in Asian countries among engineers, researchers and academia professors. The emphasis will be on improving our knowledge in meeting geoengineering requirements for a long-term sustainable urban development and the need to protect and preserve our environment. We look forward to having the pleasure of welcoming you all in Changsha.

Symposium theme

Environmental friendliness, sustainability and diversity in urban geoengineering

Topics

- Fundamental behavior and constitutive model of geomaterials;
- Excavation engineering;
- Tunneling;
- Urban environmental geotechnical problems and disaster effects;
- Risk and safety assessment, management and control in urban geoengineering;
- Design standards of deep excavation among Asian countries

Extensively urban construction is going on in Asian countries, environmental friendliness and sustainability are emphasized in modern urbanization processes. Environmental friendliness addresses the control of ground movement, mitigation measures and risk management. Those control or mitigation measures should be sustainable. Moreover, the performance of deep excavation and tunnels, mitigation measures and risk management are often site dependent and vary from country to country. The ground conditions, construction practices, codes and standards are very different among Asian countries. The aim of this symposium is to share knowledge and experiences of the analysis, design,

construction and maintenance of urban geoengineering among engineers, researchers and academia professors in Asian countries.

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Seventh International Conference and Exhibition on Water Resources and Renewable Energy Development in Asia
13-15 March 2018, Danang, Vietnam
www.hydropower-dams.com/asia-2018-conference.php?c_id=303

Recognizing that Asia is the region of the world with the largest current programme of water resources and hydro development, but also some of the greatest challenges to face, including natural hazards, challenging sites, and in some countries limited resources, Aqua~Media has been organizing regional conferences in Asia since 2006.

Working with the major water- and energy-related professional associations, as well as an international steering committee of world-renowned experts, the Aqua~Media team puts together a technical programme for each event which represents a unique concentration of expertise on all practical and topical areas of interest to the world water and renewable energy community. The plenary opening ceremony features national overviews of development potential and keynote addresses; parallel sessions then include paper presentations and panel discussions. Side events provide extra opportunities for training, capacity building and business networking.

Previous events in this series have taken place in: Bangkok (2006); Danang (2008); Kuching (2010); Chiang Mai (2012); Colombo (2014); and, Vientiane (2016).

A foundational theme of ASIA 2018 will be international collaboration, with much discussion focusing on transboundary projects and power trading in the Asian region. Other key topics will be climate resilience, flood management, safety of water infrastructure, synergy between renewables, finance, innovations in technology for large and small schemes, best practice in environmental and social aspects, and capacity building.

It is expected that around 50 nations will be represented, as experts from all parts of the world focus on aspects particularly relevant to Asia: the continent most active in hydropower and water resources development. Professional associations such as ICOLD, IEA, ICID, IWRA and the Mekong River Commission will be strongly represented, as well as IFIs including the Asian Development Bank and World Bank.

Themes for discussion in sessions, panels and workshops

Planning and development

- Review of plans and progress in Asian countries
- The value of integrated regional development
- Project preparation; making projects bankable
- Tools for project assessment, economic studies and design
- International and cross-border cooperation
- Appropriate project planning and benefit sharing
- Grid operation: national and integrated regional systems
- Small schemes for rural development
- Marine energy prospects in Asia

Finance, economics and commercial and legal aspects

- Securing project finance for water and energy infrastructure
- Carbon credits, carbon trading and income diversification
- Power trading and purchase agreements
- Legal and contractual issues

Hydrology and flood management

- Flood mitigation and management
- Early warning systems
- Implications of climate change and climate resilience strategies
- Water infrastructure and flood discharge works (innovation, efficiency, safety and economy)
- Innovative spillway design

Civil works and challenging site conditions

- Site planning for safety and efficiency
- Remote sites and extreme climates
- Construction management
- Benefits of multipurpose schemes, including case studies
- Materials for dams: past experience and future developments
- Selecting appropriate construction equipment
- Seismic design and tackling complex geology
- Innovative solutions in design and construction
- Sedimentation: planning and design approaches
- Tunnels and underground power caverns

Safety of water infrastructure

- Managing natural hazards: strategies and case studies
- Learning from accidents and failures at dams and tunnels
- Upgrading of dams and spillways to meet higher safety standards
- Health and safety of the workforce on site
- Safety issues especially relevant to small dams

Technology: hydro and other renewables

- Emerging trends in renewable energy development
- Hydro in synergy with other renewable energy sources
- Hydro turbines and generators (large, small and micro)
- R&D and innovation: Modelling, testing and monitoring
- Maintenance and timely refurbishment
- Instrumentation, control and cyber security
- Powerplant safety: learning from incidents and failures
- Optimizing operation of powerplants and reservoirs
- Pumped storage: technology, role in the grid and benefits
- Gates, valves and hydromechanical equipment

- Workforce training: health and safety aspects
- Appropriate low cost solutions for rural electrification
- Transmission and distribution

Environmental and social aspects
- Impact assessment: methodology and experience
- Integrated regional development
- Mitigation measures for environmental and social impacts
- Greenhouse gas emissions from reservoirs
- Fish protection
- Facilitating communications with project-affected people
- Enhancing socio-economic development in rural areas

Succession planning
- Technology transfer
- Approaches to capacity building
- Available training courses
- International exchange programmes

Hydropower & Dams, Aqua~Media International Ltd
PO Box 285, Wallington. Surrey, SM6 6AN, UNITED KINGDOM.

World Tunnel Congress 2018 "The Role of Underground Space in Future Sustainable Cities", 20-26 April 2018, Dubai, United Arab Emirates, www.wtc2018.ae

EUROCK 2018

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

THEMES

- Physical and mechanical properties of fractured rock (laboratory testing and rock properties, field measurements and site investigations)
- Geophysics in rock mechanics
- Rock mass strength and failure
- Nonlinear problems in rock mechanics
- Effect of joint water on the behavior of rock foundation
- Numerical modeling and back analysis
- Mineral resources development: methods and rock mechanics problems
- Rock mechanics and underground construction in mining, hydropower industry and civil engineering
- Rock mechanics in petroleum engineering
- Geodynamics and monitoring of rock mass behavior
- Risks and hazards
- Geomechanics of technogenic deposits

CONTACTS

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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

NUMGE 2018

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

Technical Committee (ERTC7) has the pleasure of inviting you to attend the 9th NUMGE Conference on Numerical Methods in Geotechnical Engineering in Porto, Portugal, 25-27 June 2018. This conference is the ninth in a series of conferences on Numerical Methods in Geotechnical Engineering organized by the ERTC7 under the auspices of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

The first conference was held in 1986 in Stuttgart, Germany, and the series continued every four years (1990 Santander, Spain; 1994 Manchester, United Kingdom; 1998 Udine, Italy; 2002 Paris, France; 2006 Graz, Austria; 2010 Trondheim, Norway; 2014 Delft, The Netherlands).

The conference provides a forum for exchange of ideas and discussion on topics related to numerical modelling in geotechnical engineering. Both senior and young researchers, as well as scientists and engineers from Europe and overseas, are invited to attend this conference to share and exchange their knowledge and experiences.

Conference Themes

The Scientific and Organizing Committees of NUMGE2018 invite geotechnical engineering researchers and practical

engineers to submit abstracts on scientific achievements, innovations and engineering applications related to or employing numerical methods.

Regarding the theoretical themes, the following are pointed out, among others:

- Constitutive modelling and numerical implementation.
- Numerical algorithms and theoretical aspects.
- Finite element, discrete element and other numerical methods. Coupling of diverse methods.
- Reliability and probability analysis.
- Large deformation – large strain analysis.
- Artificial intelligence and neural networks.
- Ground flow, thermal and coupled analysis.
- Unsaturated soil mechanics.
- Earthquake engineering, soil dynamics and soil-structure
- interactions.
- Rock mechanics.

Abstracts on practical applications are welcome, namely related to the following types of works:

- Application of numerical methods in the context of the Eurocodes.
- Shallow and deep foundations.
- Slopes and cuts.
- Supported excavations and retaining walls.
- Embankments and dams
- Tunnels and caverns (and pipelines).
- Ground improvement and reinforcement.
- Offshore geotechnical engineering.
- Propagation of vibrations and mitigation measures.

Contact

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

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

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

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

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

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

7 ICEGE 2019

International Conference on Earthquake Geotechnical Engineering
17 - 20 June 2019, Rome, Italy

Organizer: TC203 and AGI (Italian Geotechnical Society)
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ISDCG 2019

7th International Symposium on Deformation Characteristics of Geomaterials
26 - 28 June 2019, Glasgow, Scotland, UK,

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

Building on the success of the previous Symposia organised in Sapporo (Japan) Japan in 1994, Torino (Italy) in 1999, Lyon (France) in 2003, Atlanta (US) in 2008, Seoul (Korea) in 2011 and Buenos Aires (Argentina) in 2015, the 7th ISDCG will equally follow both its traditions and active promotion of new technical elements to maintain it as one of the most popular and vibrant events within the geotechnical community. The technical core themes will focus on: (i) advanced laboratory geotechnical testing; (ii) application of advanced laboratory testing in research, site characterisation, and ground modelling; (iii) application of advanced

testing to practical geotechnical engineering. In addition to these traditional topics, sub-themes will include cutting-edge techniques and approaches, for example experimental micro-mechanics, non-invasive monitoring systems, nano and micro-sensors, new sensing technologies. A key goal is to engage with the full spectrum of geotechnical specialists, from early career engineers and researchers through to world leading experts.

14th ISRM International Congress
20-27 September 2019, Foz de Iguaçu, Brazil

Contact Person: Prof. Sergio A. B. da Fontoura
E-mail: fontoura@puc-rio.b

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

The theme of the conference embraces all aspects of geotechnical engineering. Geotechnical engineering is the foundation of current as well as future societies, which both rely on complex civil engineering infrastructures, and call for mitigation of potential geodangers posing threat to these. Geotechnical means and solutions are required to ensure infrastructure safety and sustainable development. Those means are rooted in past experiences enhanced by research and technology of today.

At great events such as the European Geotechnical Conference we should: Spread our knowledge and experience to our colleagues; Introduce innovations, research and development of techniques and equipment; Report on successful geotechnical constructions and application of geotechnical design methods, as well as, on mitigation and assessment of geohazards and more.

Such events also provide an opportunity to draw the attention of others outside the field of geotechnical engineering to the importance of what we are doing, particularly to those who, directly or indirectly, rely on our services, knowledge and experience. Investment in quality geotechnical work is required for successful and safe design, construction and operation of any infrastructure. Geotechnical engineering is the key to a safe and sustainable infrastructure and of importance for the society, economy and the environment. This must be emphasized and reported upon.

XVI Asian Regional Conference on Soil Mechanics and Geotechnical Engineering
21 - 25 October 2019, Taipei, China

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

Technical program

1A – Transportation geotechnics.
1B – In situ testing.
1C – Geo-engineering for energy and sustainability.
1D – Numerical modelling in geotechnics.
1E – Foundations & ground improvement.
1F – Unsaturated soils.
1G – Embankments, dams and tailings.
1H – Excavations and tunnels.
1I – Geo-Risks.

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

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ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Millennium Tower reviewed building design, but not the ground

"My interests went as far as the concrete," says engineer who reviewed the troubled tower

The developers behind the sinking Millennium Tower paid for an independent review of the tower itself before it was built, but not of the site it sits on, according to new testimony at City Hall on Thursday.

The Government Audit and Oversight Committee quizzed Jack Moehle, a professor of structural engineering at UC Berkeley, whom Millennium Partners and its engineer consultants hired to conduct an independent peer review of the building design while it was being entitled.

"The interest was to do an internal review to ensure that the structural system selected was suitable," Moehle told city lawmakers at Thursday's hearing. "[So] that if there was a formal peer review for the city later that most questions would be dealt with already."

Moehle says he inspected the high-rise's design from top to bottom—but no lower than the bottom. A geotechnical review—i.e., an assessment of the condition of the soil under the building site—wasn't part of the process, because no one ever hired a geotechnical engineer.

[**Update:** Note that Moehle's testimony referred only to the lack of a geotech engineer on the voluntary review conducted by the developer ahead of time.]

"My interests went as far as the concrete mat," says Moehle, referring to the slab that forms the base of the building.

The condition of the dirt matters because the 58-story, concrete-framed Millennium Tower's foundation design relies on the properties of the soil to keep the building in place.

As an Iowa State University design professor explained it:

"Imagine driving a broomstick into beach sand–you can only go so far before there's enough broomstick in contact with the sand to put up fearsome resistance. This has always been a standard technique for building in liquid soil, and it's why coastal construction always comes with the dulcet tones of a pile driver."

The building sits on hundreds of giant concrete "sticks" that use soil friction to hold the concrete slab in place. So the behavior of all that dirt matters.

Moehle told supervisors Thursday that all he said was that the foundation was up to code, not that it would necessarily work as intended. "I'm not qualified to do that."

Supervisor Aaron Peskin pressed Moehle on why he didn't insist on an analysis of the ground, saying: "[Your] letter says, I have reviewed the design criteria and find it acceptable ... But you don't have any language in your letter: Be forewarned, you may want to get a geotechnical consultant?"

To which Moehle replied, "It wasn't my place," pointing out that many projects opt not to examine the soil and, since foundations must be built first, developers are usually eager to expedite its review.

Via email, a spokesperson for Millennium Partners says "It was clear from Professor Moehle's testimony that Mission Street Development met and in fact exceeded the requirements of the city" by paying for the independent review.

(Adam Brinklow / CURBED SAN FRANCISCO, Feb 3, 2017, https://sf.curbed.com/2017/2/3/14500782/millennium-tower-peer-revie)

New Report Urges Performance-Based Approach to Liquefaction

The National Academies of Sciences, Engineering, and Medicine examines this key seismic topic and makes 11 recommendations.

A new report by the National Academies of Sciences, Engineering, and Medicine examines soil liquefaction and its consequences, such as this liquefaction-induced soil spreading event in Christchurch, New Zealand in 2011. Wikimedia Commons/Schwede66

A new report developed by a committee of engineers and scientists and issued by the National Academies of Sciences, Engineering, and Medicine, of Washington, D.C., seeks to elucidate the causes of liquefaction and its consequences and urges the geotechnical engineering community to move toward a performance-based approach to the issue.

The committee was convened by the organization's Committee on Geological and Geotechnical Engineering in response to work by an ad hoc committee of the Earthquake Engineering Research Institute, a technical society head-

quartered in Oakland, California. The latter committee found that the complexities of liquefaction and the current scientific understanding of it called for further review and resolution.

"The topic of assessing the potential for earthquake-induced liquefaction is one that has been discussed a lot within the technical community. There have been various methods that have been put forward, with differences of opinion as to how you treat different correction factors or what you do with the data," explains Sammantha Magsino, the director of the Committee on Geological and Geotechnical Engineering.

The committee was chaired by Edward Kavazanjian, Jr., Ph.D., P.E., D.GE, M.ASCE, a regents' professor and the Ira A. Fulton Professor of Geotechnical Engineering at Arizona State University and a former president of ASCE's Geo-Institute. Its report is entitled *State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction and Its Consequences*, and the authors included experts in liquefaction, lab testing, modeling, and geology.

The committee found that current models used to assess an earthquake's potential to trigger liquefaction are in substantial agreement when used to predict events within the earthquake magnitude and depth ranges constrained by the data. However, much of this data focuses on motions occurring from 5 to 50 ft below the surface and as a result of earthquakes of magnitude 6.5 to 8.0. Beyond these limits, the methods diverge in their predictions. It also noted the significant uncertainties in assessing the consequences of liquefaction even when triggering can be predicted with reasonable certainty.

"I think uncertainty was a theme that ran through the report," Kavazanjian says. "There is uncertainty around soil conditions. There is uncertainty around ground motions. There is uncertainty about the response of structures. So, there is a tremendous amount of uncertainty in every step of the process. I think one of the most important recommendations from the committee is [that] we need to quantify and account for these uncertainties."

Part of this uncertainty arises because much of the liquefaction data that the technical community possesses come from postearthquake assessments. And those data understandably relate to soil properties and ground displacements where liquefaction is evident at the ground surface. This makes it especially difficult to accurately predict the effects of liquefaction on buildings, highways, and other facets of infrastructure. Many areas that experience liquefaction without surface manifestations probably go unmeasured.

To address this, one of the committee's recommendations is to establish a series of field observatories in areas with a high probability of earthquake-induced liquefaction. By characterizing the geology of the site, instrumenting the site to capture the generation of liquefaction during a seismic event, and then noting the effects of liquefaction on structures, the geotechnical engineering community would gain valuable data about the liquefaction process and its consequences.

The committee made a total of 11 recommendations. Magsino advised the committee to make recommendations in areas that could be improved immediately using today's tools and technologies, as well as in areas related to larger issues that hold promise for advancing the field. For example, the observatories mentioned above would require an initial investment followed by a continuing commitment to maintain the equipment, but years or decades could elapse before data became available.

The report also recommends using cone penetrometers where feasible for site testing since the results they provide tend to be more consistent that those provided by the standard penetration test. Other recommendations include quantifying the uncertainty in empirical methods used to assess the likelihood of liquefaction and its consequences, moving toward performance-based design procedures, developing common protocols for liquefaction data collection, establishing a common database for such data, and continuing vigorous research to develop and refine models for liquefaction and its consequences based on engineering mechanics and geological and seismological principles.

The committee concluded that a goal for the field is to move toward an integrated approach that would assess the potential for liquefaction at a site, the consequences of such liquefaction, and the cost of improving the resiliency of the site in relation to the cost of the expected damage, Kavazanjian says.

"We have crude models to do that right now, but . . . [there is] a lot of work that needs to be done to achieve that goal," he says.

The report was funded by ASCE; the Los Angeles Department of Water and Power; the Port of Long Beach, California; the Port of Los Angeles; the U.S. Department of the Interior's Bureau of Reclamation; the U.S. Department of Transportation's Federal Highway Administration; and the U.S. Nuclear Regulatory Commission.

The breadth of funding is "a testament to how important this topic is . . . for so many different sectors of our society, so many different parts of our economy, so many different kinds of infrastructure," Magsino says.

(Kevin Wilcox / Civil Engineering / ASCE, February 7, 2017, http://www.asce.org/magazine/20170207-new-report-urges-performance-based-approach-to-liquefaction)

Oroville Dam risk: Thousands ordered to evacuate homes

Water crashes through the main spillway at the Oroville Dam

More than 180,000 people in northern California have been told to evacuate after two overflow channels at the US's tallest dam were found to be damaged.

The 770ft (230m) high Oroville Dam is not itself at risk of collapsing, but its emergency spillway was close to caving in, officials said.

Officials feared the damaged spillway could release large amounts of floodwater downstream.

The excess water has now stopped flowing.

However, late on Sunday, Butte County Sheriff Kory Honea said the evacuation orders remained in place.

Water levels in the reservoir have risen following heavy rain and snow after years of severe drought.

It is the first time that Lake Oroville, which lies 65 miles (105km) north of Sacramento, has experienced such an emergency in the dam's near 50-year history.

The evacuation order came after water levels in the reservoir rose sharply last week. The dam's main spillway, also known as an overflow channel, was found to be damaged.

As the water rose even higher, the dam's emergency spillway was activated for the first time since its completion in 1968.

However, this secondary slipway was also found to be damaged.

In a statement posted on social media on Sunday afternoon, Mr Honea ordered residents to evacuate, repeating three times that it was "NOT a drill".

The California Department of Water Resources warned that the emergency spillway next to the dam was "predicted to fail".

Video: What went wrong with US dam?
http://www.bbc.com/news/world-us-canada-38952847

There was gridlock on roads heading out of Oroville, a town of 16,000 people, with some evacuees complaining that they should have been given more warning.

One evacuee, Nancy Borsdorf, told AP she "panicked" and was in such a hurry to leave she "grabbed some wet laundry. Can you believe that?"

Several hours after the evacuation order, the emergency spillway was still standing.

A highway patrol officer directs traffic as residents evacuate Marysville, south of Oroville Dam

However, California Fire Incident commander Kevin Lawson said officials stood by the decision to evacuate residents, rather than risk thousands of lives.

He said if the situation was not dealt with they were looking at "a 30ft wall of water coming out of the lake".

The California Department of Water Resources said it was releasing as much as 100,000 cubic feet (2,830 cubic metres) of water per second from the main spillway to try to lower the lake's level and relieve the pressure.

Helicopters were dispatched to drop boulders to try to block the eroded area in the spillway.

The emergency spillway at the dam was predicted to collapse

Butte County's official Twitter feed shared news of emergency shelters, and reported that many hotels were fully booked in the wider area.

One local resident, Javier Santiago, moved his family to the dam's visitor centre, which sits at the top of the structure and away from the flow of water.

"We're going to sleep in the car," he told Reuters news agency, adding that he had packed blankets, pillows and a little food for himself, his wife and their two children.

Gurtej Singh, a manager at a Sikh centre in Sacramento, said the local mayor's office contacted his organisation to ask if they would host evacuees.

"We, in turn, put a call out to members of our community to see if they could provide food, bedding etc, so that around 50 people could stay at our centre," he told the BBC.

Land beside the lake has experienced erosion because of overflowing water

Sheriff Honea said that the evacuation was declared to avoid a "worst-case scenario".

He added that no decision had been made as to when people would be allowed back into their homes, as the authorities were still assessing the risks.

Doug Carlson, from the California Department of Water Resources, told the BBC that the situation was looking positive, as the lake level had dropped during the night after the emergency measures were taken.

"That's very good news for the people downstream," he said.

California Department of Water Resources staff monitor the water flow

After a long period of drought, California has been experiencing heavy rain and increased snowfall, which has led to flooding and mudslides.

On Friday, California Governor Jerry Brown asked the Federal Emergency Management Agency to declare a major disaster.

Workers inspecting a damaged part of the Lake Oroville spillway earlier in the week

(BBC News, 13 February 2017, http://www.bbc.com/news/world-us-canada-38952847)

2 dams illustrate challenge of maintaining older designs

Twelve years ago, widespread destruction from Hurricane Katrina on the Gulf Coast helped compel federal engineers 2,000 miles away in California to remake a 1950s-era dam by constructing a massive steel-and-concrete gutter that would manage surging waters in times of torrential storms.

The nearly $1 billion auxiliary spillway at Folsom Dam, scheduled to be completed later this year, stands in contrast to the troubles 75 miles away at the state-run Oroville Dam, where thousands of people fled last week after an eroded spillway threatened to collapse - a catastrophe that could have sent a 30-foot wall of floodwater gushing into three counties.

Together, the two dams illustrate widely diverging conditions at the more than 1,000 dams across California, most of them decades old. The structures also underscore the challenge of maintaining older dams with outdated designs.

"Fifty years ago, when we were evaluating flood risk, the fundamental assessment was the climate was stable, not changing. We now know that is no longer true," said Peter Gleick, chief scientist with the Pacific Institute, a California-based think tank specializing in water issues.

"We need to look at the existing infrastructure with new eyes," he warned.

(Michael R. Blood / Associated Press - The Washington Times, Sunday, February 19, 2017, http://www.washingtontimes.com/news/2017/feb/19/2-dams-illustrate-challenge-of-maintaining-older-d)

Damage to Oroville's main spillway 'was an accident waiting to happen'

The badly damaged main concrete spillway at Oroville Dam was pounded by massive volumes of stormwater this

month, but its failures occurred well short of the maximum flow that engineers designed the system to handle.

The spillway began breaking apart when its gates were opened Feb. 7, allowing 55,000 cubic feet of water per second to roar down the slope. That was only 18% of the 300,000 cubic feet of water the channel was designed to carry per second, one of the factors that raise significant questions about its design integrity, engineering experts said. Eventually, the gash that opened up had grown to 500 feet in length and dug a hole 45 feet deep in the earth.

Weakness in the aged concrete, inadequate repairs of cracks and instability in the ground under the spillway caused large pieces of concrete to break apart and tumble downhill, said Robert Bea, a retired civil engineering professor at UC Berkeley who led one of the investigations into the failures of the New Orleans levee system in Hurricane Katrina's wake.

The failures in the concrete spillway will be investigated for a long time. But some of the nation's top civil engineers are already pointing to some likely suspects: design flaws, misunderstood geology and poor maintenance over the years.

The Federal Energy Regulatory Commission, which has jurisdiction over the Oroville Dam, ordered the state on Feb. 13 to conduct a "forensic analysis" of the damage and said it was appointing an independent board of consultants that would have broad powers to review the investigation and oversee the repairs.

Nancy Vogel, a spokeswoman for the Department of Water Resources, which operates the dam, said in a statement: "Everyone will benefit from a full analysis of this incident, which is exactly what we will do. Right now our top priority is public safety and managing the active emergency response."

The spillway is not part of the dam, but it is one of the most crucial safety systems at the site. It must sustain tremendous forces when storms fill the reservoir to its capacity, which was the crisis facing state engineers after continuous rains in Northern California had swollen the Oroville impoundment. When they opened the control gates, water rushed down the 3,000-foot-long spillway, which drops about 700 feet in elevation, at estimated speeds of more than 50 mph.

The forces the water imposed on the 50-year-old structure were enormous, far greater than those of a big rig truck pounding a highway. The dead weight of the water alone was more than 5 tons per square foot, and as it poured down the spillway its undulating motion exerted even more force on the concrete, Bea said.

Bea, a member of the National Academy of Engineering, bases his analysis on a review of inspection documents, original design documents and photographs of the damage, as well as interviews with engineers who helped design the dam.

Inspection reports show that trees had been growing next to the spillway, which could have damaged the ground that supported the heavy structure. When they were removed, they left bare ground adjacent to the spillway, a weak point, Bea said. Recent photos show that trees continue to line the area of the damage, which undercut the spillway's vertical wall. In New Orleans, the failure of levees well below the forces they were designed to withstand was traced to a poor understanding of the strength of the soil.

An incident report by the Department of Water Resources also raises the possibility that the spillway was undermined by water running downhill outside the spillway, which eroded rock and soil that supports the structure. Any previous damage by the tree roots could have allowed the runoff to more easily wash away rock and soil, Bea said. A photograph of the damaged area shows erosion outside the wall of the spillway.

The dam was one of many built in a flurry of construction in the 1960s, when engineering analysis was far less sophisticated than it is today and engineers had to rely on slide rules rather than computational models.

"It was an accident waiting to happen from Day One," said Don Colson, a retired engineer who worked on the Oroville Dam design in the 1960s and went on to a 36-year career at the state water agency. "This was a mistake that went back to the very beginning."

Colson, who worked on other parts of the dam, said the design of the spillway never fully analyzed the potential for cavitation, which occurs when roiling water creates air pockets that cause high-pressure intrusion into cracks and fissures. The action can chew through thick concrete and even steel.

Dam spillways have a long history of problems with cavitation. The spillways at Hoover Dam have been used twice, and both times they sustained heavy damage, similar to what happened at Oroville. Cavitation caused concrete to fail and resulted in scouring of the surrounding rock. Glen Canyon Dam, also on the Colorado River, sustained massive damage in 1983 when its underground spillways were put to use. Dams in Pakistan and Brazil have also proved the potential for cavitation to damage spillways.

J. David Rogers, a dam expert at Missouri University of Science and Technology who has written books on past dam failures, said long spillways such as the one at Oroville create difficult engineering problems. A 3,000-foot stretch of concrete can shrink 15 feet as it cures, creating gaps between panels. Thermal expansion and contraction over the years reopens gaps, allowing cavitation to expand the holes.

Oroville's spillway was also fighting gravity, having a tendency to slide downhill, opening more gaps on its surface over the years, Rogers said. Meanwhile, the long drought probably caused the underlying soil to shrink, creating underground fissures that the drenching rains this year would have easily filled in the foundation, he said.

"You have to grout these things in perpetuity, and that is what we are doing a poor job on as nation and a state," Rogers said.

The Army Corps of Engineers and the American Society of Civil Engineers have long warned that many of the nation's dams are not receiving adequate maintenance. Rogers said that over the years, dams have operated closer to their maximum storage, providing less space for flood control, as political pressure has grown to maximize water storage and electrical generation.

All of the engineers said the state will likely have to replace the entire spillway, given the damage that occurred at such a moderate rate of discharge. That could cost more than $100 million, they estimated. And there are hundreds of thousands of cubic yards of debris that were deposited in the Feather River that will have to be dredged out to allow the dam to operate normally.

(Ralph Vartabedian / Los Angeles Times, 20 Feb. 2017, http://www.latimes.com/local/california/la-me-ln-oroville-spillway-damage-20170220-story.html)

The terrifying moment of a landslide in Bolivia's capital

The terrifying moment of a landslide in Bolivia's capital.

https://www.youtube.com/watch?v=6FKhmeG1y5U

Footage captured the moment homes were destroyed in a landslide in La Paz, Bolivia, on Wednesday.

The landslide rolled off the mountainside into the Auquisamaña area of the Bolivian capital.

No casualties were reported.

(The Wall Street Journal, 21 February 2017, http://www.wsj.com/video/landslide-destroys-homes-in-bolivia/5D083F1B-3DF7-46A6-88DE-EBC3BF58A03B.html)

Take a Tour of World Record Arch Dams

Classically curved, see some of the most distinctive structures built or still under construction

Arch dams, classically curved monoliths situated in narrow valleys, are not as common as other types of dams, such as embankment dams and gravity dams.

ACS, based in Spain, is one of the most active dam contractors internationally, and has constructed 23 arch dams since 1960. It's subsidiary Dragados completed Portugues Dam, a 67-meter tall, 275-meter long roller-compacted concrete thick-arch dam, in Puerto Rico in 2013. And it is nearing completion of the Barro Blanco Dam in Panama. Barro Blanco is an arch-gravity dam of conventional concrete in the central section and loose materials in the buttresses. It is 55 meters tall, with a crest length of 332 meters for the concrete section, plus 138 meters for the buttresses.

In recent years, ACS's subsidiary Cobra has been building dams in Panama, Guatemala, Peru and Nicaragua. "There is an added difficulty that has to do with working in depressed regions," says Javier Hidalgo, Cobra's Director of Hydraulic Infrastructure.

Regarding arch dams, "the major challenge in terms of construction is the transportation and placement of concrete, which generally requires special tailor-made systems such as cableways. Additionally, project-specific specialized formwork systems are required, due to the curvature of the dam face," says Luis Miguel Viaria Laborde, Director of Technical Research, Development and Investigation for Dragados, a subsidiary of ACS.

MWH, a subsidiary of Stantec, has designed a number of arch dams. The firm provided design review, preparation of construction drawings, and on-site construction management of the Tekeze hydropower project in Ethiopia, a 190-meter tall double arch dam with a 300 MW underground powerhouse, that was completed in 2009. And MWH acted as technical advisors on the design of the Jinping I Dam in China, the world's tallest arch dam. The firm completed the feasibility level design of the Susitna-Watana hydroelectric project in Alaska, a 224-meter tall gravity-arch dam projected to cost $5.2 billion, that was shelved in June, 2016.

MWH served as owner's engineer for client American Municipal Power as it added powerhouses to four existing locks and dams on the Ohio River. Since only three percent of U.S. dams currently have hydropower, "this is a large untapped source of clean renewable power in the U.S.," says Don Erpenbeck, vice president & global sector leader, water power and dams, Stantec.

"With the deteriorating infrastructure in North America, there will likely be significant growth in the hydropower sector," comments Jane Griffin, head of global media relations for Bechtel's Infrastructure group. "As we recently saw at the Oroville Dam in California, there are likely to be a number of hydropower facilities that need significant rehabilitation work in the not too distant future." The Report Card, issued every four years by the American Society of Civil Engineers, left the dam grade unchanged from 2009 and determined that the United States needs to invest an

estimated $54 billion over the next five years in order to rehabilitate all of the dams that require rehabilitation. Of this amount, $21 billion is needed to repair the nation's high-hazard potential dams to bring them into a safe condition.

"South America and Africa both provide significant hydropower opportunities in high growth developing countries," says Griffin. "Hydroelectric power generation is one of the most widespread, dependable and renewable power generation resources on the planet, constituting approximately 15% of the world's total power supply. Despite this, it has been estimated that only roughly one-fifth of the world's total hydropower potential has been developed."

Oil prices have a significant impact on the hydropower market. "There is a decrease in the construction of hydroelectric power stations coinciding with low oil price periods…we are situated in one of those periods," says Laborde. "We are currently facing a shortage of supply of new projects. This has increased the competition among companies based on a reduction of margins. New projects are, for the most part, private initiatives following an engineer-procure-construct format, where the contractor assumes the totality of the inherent risks related to the execution."

The largest arch dam currently under construction in the world is the Baihetan Dam, on China's Jinsha River, the upper reach of the Yangtze. When completed, it will be 277 meters tall. Its underground powerhouse will contain 16 turbines, with a generating capacity of 14,000 MW. The contractor is China International Water & Electric Corp., a subsidiary of China Three Gorges Corp. Construction began in 2013 and the first power is expected to be generated in 2018, with final completion in 2020.

Another huge arch dam under construction is the Yusufeli Dam on the Coruh River in northeast Turkey. When completed, it will be 270 meters tall and 490 meters long. It was designed by Su-Yapi Engineering and Consulting Inc., and is being built by the Limak Holding-Cengiz Holding-Kolin consortium. The dam will have a generating capacity of 540 MW. Construction started in 2013, and it is expected to be completed in May 2018.

Jinping-I Dam, at 305 meters, is the tallest arch dam in the world. It is located on the Yalong River, a tributary of the Yangtze River, in Sichuan Province in southwest China. It was designed by the East China Investigation and Design Institute, and built by Sinohydro Bureau 7 Co. Ltd. Construction started in 2005 and was completed in 2012. It's power station features six 600 MW Francis-type turbines, giving it a total installed generating capacity of 3,600 MW. The six turbines are located in an underground powerhouse 277 meters long by 29.2 meters wide by 68.82 meters high.

Xiaowan Dam, at 292 meters in height, is the second tallest arch dam in the world. It spans the Mekong (Lancang) River in Yunnan Province in southwest China, with a length of 902 meters. It was constructed from 2002 to 2010 by Sinohydro Bureau 1,37, 8 & 14 Co. Ltd., at a cost of $3.9 billion. It's hydropower plant features six 700 MW turbines, giving it a total generating capacity of 4,200 MW. The dam is operated by Yunnan Huaneng Lancang Hydropower Co. It impounds one of the largest reservoirs of any dam in China, with a total capacity of 15.04 billion cubic meters.

Xiludou Dam, at 286 meters, is the third tallest arch dam in the world. It is located on the Jinsha River (the upper section of the Yangtze), in southwest China. Construction began in 2005 and the first generator was commissioned in 2013. It was built by China Three Gorges Corp., at a cost of $6.2 billion. It features two underground power stations, each containing nine 770 MW turbines. It's total installed capacity of 13,860 MW ranks it as the third largest power station in the world, behind only Three Gorges Dam and Itaipu Dam.

Kariba Dam is an arch dam on the Zambezi River between Zambia and Zimbabwe. It forms Lake Kariba, which holds 185 billion cubic meters of water, the largest reservoir in the world. It was designed by Gibb, Coyne, Sogei (Kariba) (Pvt.) Ltd., a combination of Sir Alexander Gibb & Partners

(UK); Andre Coyne & Jean Bellier (France); and Societe Generale d'Exploitations Industrielles (France). It was built by Impresit of Italy, and completed in 1959. The creation of the reservoir forced the resettlement of 57,000 Tonga people. At a Zambezi River Authority conference in 2014, engineers warned that the dam's foundations had weakened, due to torrents from the spillway eroding the basalt bedrock the dam rests on. The World Bank is organizing a $294 million repair project, which will excavate 300,000 cubic meters of rock and reshape it, to strengthen the dam and prevent further erosion.

Daniel-Johnson Dam, formerly called the Manic-5 Dam, is the longest multiple-arch buttress dam in the world. Featuring 13 arches and 14 buttresses, it spans the Manicouagan River in Canada with a length of 1,314 meters. It was designed by Andre Coyne of the firm Coyne et Bellier. Hydro-Quebec, the owner, used its own forces for all the above-ground construction, and hired Janin Construction Co. to handle the tunneling. It is 214 meters tall, and has a generating capacity of 2,596 MW. Construction began in 1959 and was completed in 1968, and it went into service in 1970.

(Scott Lewis / ENR - Engineering News-Record, 21 Feb. 2017, http://www.enr.com/articles/41513-take-a-tour-of-world-record-arch-dams)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Scientists may have actually found a lost continent

We can only guess at what Mauritia might have looked like, because it probably lies between three and six miles under the sea.

The lost continent of Mauritia likely spanned a great swathe of the Indian Ocean before it was torn apart by indomitable geologic forces and plunged into the sea. Now, a good chunk of it may have been found.

In 2015, researchers visited the island of Mauritius, east of Madagascar, to study volcanic rocks. While there, they unearthed something unexpected. Embedded in the rocks were ancient crystals, dated up to three billion years old—300 times older than the island's young volcanic surface. Rocks this old come from Earth's continents, but there aren't any continents around Mauritius. It's surrounded by boundless sea in all directions. There was just one place left for the researchers to look—down. Their findings, published in the journal *Nature Communications* (Archaean zircons in Miocene oceanic hotspot rocks establish ancient continental crust beneath Mauritius, *Nature Communications* **8**, 31 January 2017, http://www.nature.com/articles/ncomms14086?dom=icopyright&src=syn#auth-1), suggest that the curious crystals came from a long-forgotten place buried well beneath the island.

"This exciting and unexpected result can only mean that there is a piece of ancient continent below the young volcanoes of Mauritius," says the study's lead author Lewis Ashwal, who researches geoscience at the University of Witwatersrand in Johannesburg, South Africa.

The idea that a massive slab of missing land may lie under Mauritius was first suggested by Ashwal in 2013. Among the island's sandy beaches, Ashwal and his team found minuscule zircon crystals that were nearly 2 billion years old, raising his suspicions about the not-so-mythical continent. But detractors argued that the microscopic crystals could have traveled to the beach in any number of ways—no matter how unlikely—and it was simply impossible to prove those alternatives wrong. Perhaps a primordial crystal from Africa lodged in a bird's feathers and serendipitously fell to the ground, for example. "There were many skeptics in the science community who criticized our suggestion because they felt that zircons on the beach sand could have been transported there by winds, or ocean currents, or birds, or vehicle tires, or by people's shoes," says Ashwal.

But after finding ancient zircon crystals implanted in the island's rock, Ashwal confidently put those skepticisms to rest.

The island of Mauritius is blanketed in volcanic rock, which is (geologically speaking) pretty young at nine million years of age. It's strange that the zircon crystals, which are so much older, are embedded in this youthful rock, but Ashwal has an idea about how they got there. Nine million years ago, when volcanic magma oozed out Earth's mantle, it passed through the buried lost continent before continuing to the surface and spewing lava everywhere, explains Ashwal. The zircon crystals, too tough to melt, simply hitched a ride up. They've sat on the surface ever since, waiting patiently to tell scientists Mauritia's secret.

Beneath Mauritius' volcanic surface may lie remnants of the lost continent Mauritia, believed to have been a long, thin continent, 350 square miles in size.

The discovery of this buried continental slab is fascinating in itself, but it also reveals a better account of Earth's eventful past, as continents have collided and split apart over time. Ashwal points to the supercontinent Gondwana, which once encompassed Africa, India, Madagascar, Australia, and Antarctica. It began to tear apart 200 million years ago, much like Somalia, Ethiopia, Kenya, and Tanzania are splitting away from Africa today to form the East African Rift Valley—which may one day be filled by an ocean.

But when Gondwana split apart, sending our familiar continents to their present locations, the break-up may not have been so clean. "Our work shows that continental break-up is more complex and messy than previously thought, and can result in continental fragments of various sizes, littering the ocean floor," explains Ashwal. For all its glory as a former continent, Mauritia could be considered a massive piece of continental litter.

Not all the remnants of this messy break-up disappeared. Before its tragic submergence, Mauritia may have once been connected to Madagascar. Ashwal compared the ancient zircons found on Mauritius to the ages of rocks in other places, like India and Africa, and he found the "best match" in Madagascar.

Anytime someone claims to have discovered a long-lost land, it's certainly wise to raise a skeptical eyebrow. But in this case, there's little doubt. "I'm quite convinced," says Calvin Miller, who studies earth sciences at Vanderbilt University and was not involved in the study. Miller says the profoundly old ages of the zircon crystals certainly imply that they came from bona fide continental crust. He does, however give some caution to how the crystals might have become embedded in such young rock. Ashwal's notion that

molten rock carried the crystals up through ancient crust is "not quite ironclad," says Miller. "But it would be my favorite interpretation, too."

It's also unclear how much of the lost continent actually lies beneath the island of Mauritius. "They've found ancient crystals surrounded by younger rocks," explains John Valley, who studies geoscience at the University of Wisconsin-Madison but didn't participate in the recent study. "But they haven't yet found any of the older rocks." Although the crystals provide valuable evidence for the existence of this submerged land, how much of it lies down there remains a mystery. "It could be a massive buried continent, or just trace amounts of zircon crystals," says Valley.

Regardless of how much land lurks three to six miles beneath the island, Ashwal thinks that most of Mauritia is strewn about the floor the Indian Ocean, cast into other shoals, ridges, and banks. But at least we know it's out there.

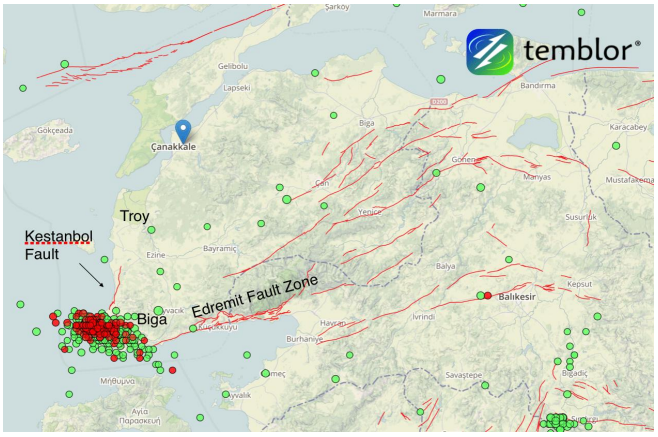
"It's not every day that a new piece of continent is discovered, even though this one is buried and we cannot see or touch it," says Ashwal.

(Mark D. Kaufman / Popular Science, February 3, 2017, http://world.einnews.com/article/365118749/4k2KGIHS_9XTvaGD?lcf=ZX9dkeSQfK-5FADPuwjBkQ%3D%3D)

Seismic swarm in Turkey gently stresses a major fault zone

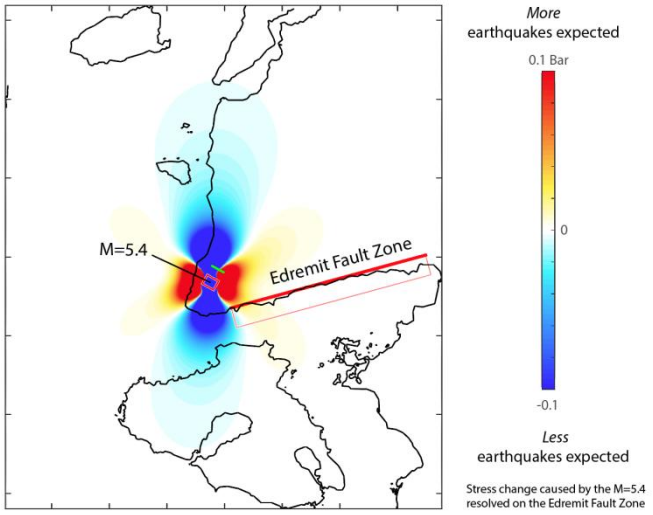
by Volkan Sevilgen (Temblor), Akın Kürçer (MTA), Hasan Elmacı (MTA)

A series of mid-sized earthquakes (also called a seismic swarm) occurred at the tip of the Biga Peninsula in Turkey at the intersection of the Kestanbol Fault and the Edremit Fault Zone. In just a few days, 800 earthquakes varying size were felt, including three damaging magnitude 5+ earthquakes. As a result, over 350 building sustained extensive damage (AFAD). Authorities also asked residents not to enter any building before official building assessment. The Turkish Government swiftly built a small village from container houses for those who needed shelter.



Temblor Map showing active faults in Turkey (MTA Faults)

We calculated that the recent seismic swarm stressed the western portions of the Edremit Fault Zone by about 0.1 bar. If we start seeing larger numbers of small earthquakes on the Edremit Fault Zone, it would suggest the fault was triggered by the seismic swarm. The last large earthquake on the Edremit fault was a magnitude 6.7 earthquake in 1944. Therefore, a similar quake in the future would not be surprising. Thus, we think the seismicity around the Edremit fault should be closely monitored.



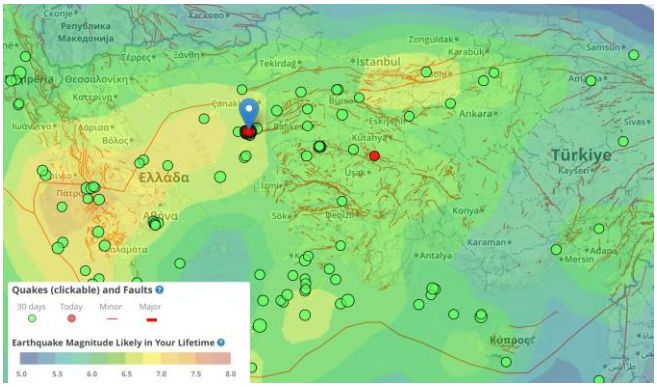
Coulomb Map Shows stress increase on the Edremit Fault Zone. The map was created in Coulomb 3. Edremit fault: Dip: 60, Rake:-90, Depth: 7.00 km, Friction: 0.4

Seismic swarms generally occur in geothermal areas where faults are lubricated by hot water, making them easier to slip. This area is one of the most active geothermal regions in Turkey, with some water temperatures reaching 174º C. Water boils at 100º C at sea level but the high pressure environment underground prevents evaporation. Most seismic swarms end without triggering a large earthquake.

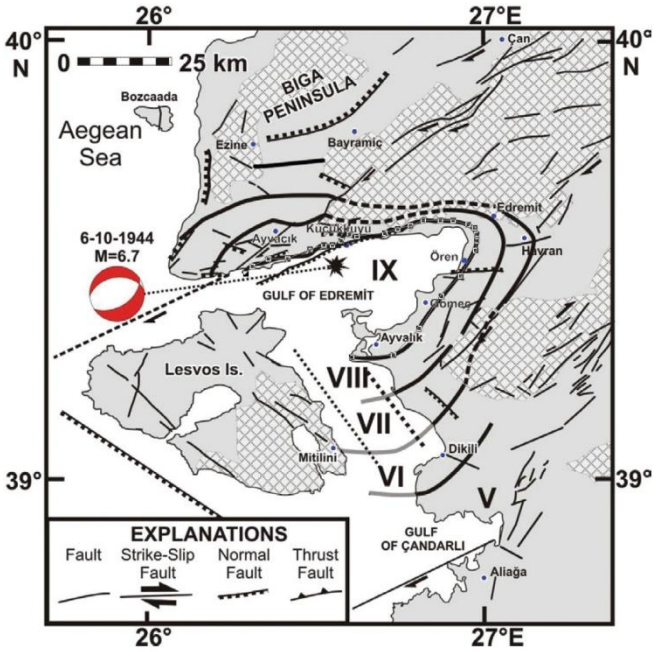
AFAD (Disaster and Emergency Management of Turkey), did an amazing job responding to residents of more than 500 damaged houses, and immediately built container housing.

Old masonry buildings are common in Turkey, Greece, and Italy, are susceptible to extensive earthquake damage. Although they can be reinforced to have more lateral support, masonry buildings generally lack the strength to withstand seismic shaking. Conversely, well-built modern structures can generally withstand the side to side motion caused by earthquakes. However, poor construction quality, unenforced building codes, and inadequate soil investigation often results in damaged buildings regardless of age.

The 1944 Edremit Earthquake reduced substandard structures to rubble and caused substantial damage to well-constructed buildings along the Gulf of Edremit, in Ayvalik, Gomen, Oren. Visible damage occurred when the strong shaking was felt. Figure is from Altinok et al 2012



Temblor earthquake forecast indicates that M=7+ quakes are likely in your lifetime in this region.



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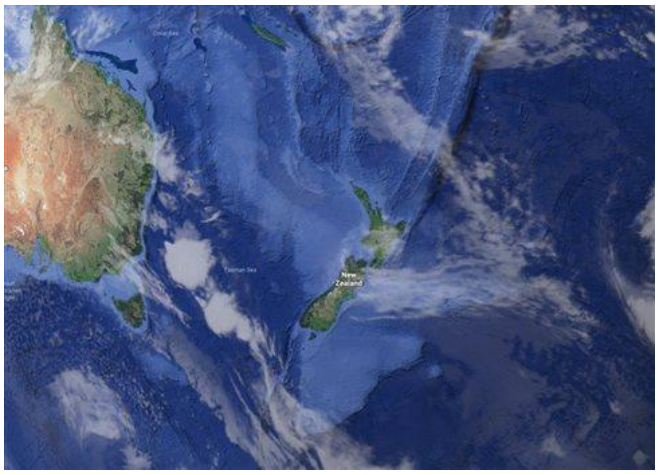
Altinok, Yalpar, Yaltirak, Özer, MACROSEISMIC EVALUATION OF THE GULF OF EDREMIT – AYVACIK EARTHQUAKE, 6 OCTOBER 1944, İstanbul Yerbilimleri Dergisi, C.25, S.1, SS. 41-53, Y. 2012

MTA (Mineral Research & Exploration General Directorate)
AFAD (Disaster and Emergency Management of Turkey)

(Posted On February 10, 2017 by Temblor, http://temblor.net/earthquake-insights/seismic-swarm-gently-stresses-large-fault-zone-2488)

Κάτω από την επιφάνεια του Ειρηνικού Ζηλανδία, η κρυμμένη ήπειρος



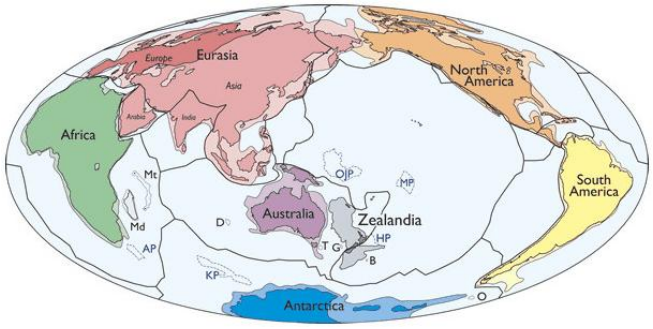
Η περιοχή της «Ζηλανδίας» όπως φαίνεται στο Google Earth

Εάν πιστεύετε ότι οι ήπειροι της Γης είναι έξι, ίσως χρειαστεί να αναθεωρήσετε. Τουλάχιστον αυτό υποστηρίζει μία ομάδα επιστημόνων, η οποία θεωρεί ότι ακόμα μία -κυριολεκτικά- κρυμμένη ήπειρος βρίσκεται ανατολικά της Αυστραλίας.

Σύμφωνα με μελέτη έντεκα ερευνητών (Zealandia: Earth's Hidden Continent), υπό τον γεωλόγο Νικ Μόρτιμερ, που δημοσιεύτηκε στο Geological Society of America, η Νέα Ζηλανδία και η Νέα Καληδονία αποτελούν τα ψηλότερα βουνά μία τεράστιας και ενιαίας πλάκας ηπειρωτικού φλοιού που είναι ξεχωριστός από εκείνον της Αυστραλίας.

Οι επιστήμονες της έδωσαν το όνομα «Ζηλανδία» (Zealandia).

Η συνολική έκταση αυτής της περιοχής είναι 4,9 εκατομμύρια τετραγωνικά χιλιόμετρα. Έχει όμως μία ιδιαιτερότητα: Βρίσκεται κατά 94% κάτω από την επιφάνεια του νοτιοδυτικού Ειρηνικού Ωκεανού.



Παρά το γεγονός ότι η «Ζηλανδία» παραμένει κατά το μεγαλύτερο μέρος της βυθισμένη, οι επιστήμονες θεωρούν ότι

γεωλογικά είναι μία σαφώς ορισμένη και ενιαία περιοχή, που αξίζει να καταταχτεί ως ήπειρος.

«Η επιστημονική αξία της ταξινόμησης της Ζηλανδίας ως ηπείρου είναι κάτι πολύ περισσότερο από ένα επιπλέον όνομα στον κατάλογο», έγραψαν.

«Το ότι μια ήπειρος μπορεί να είναι τόσο βυθισμένη, και όμως ενιαία, την καθιστά ένα χρήσιμο και τολμηρό εργαλείο για την εξερεύνηση της συνοχής και της διάλυσης του ηπειρωτικού φλοιού» προσθέτουν.

Δυστυχώς δεν υπάρχει κάποια επιστημονική επιτροπή που θα αποφασίσει εάν η «Ζηλανδία» είναι πράγματι μία νέα ήπειρος.

Η επιστημονική ομάδα που συνέγραψε τη μελέτη, αφιέρωσε έρευνα δύο δεκαετιών προκειμένου να πείσει για το επιχείρημά της. Ο χρόνος θα δείξει εάν θα γίνει αποδεκτό.

(Newsroom ΔΟΛ, 17 Feb. 2017, http://news.in.gr/science-technology/article/?aid=1500130013&ref=newsletter)

Zealandia: Earth's Hidden Continent

Nick Mortimer, Hamish J. Campbell, Andy J. Tulloch, Peter R. King, Vaughan M. Stagpoole, Ray A. Wood, Mark S. Rattenbury, Rupert Sutherland, Chris J. Adams, Julien Collot, Maria Seton

Abstract

A 4.9 Mkm^2 region of the southwest Pacific Ocean is made up of continental crust. The region has elevated bathymetry relative to surrounding oceanic crust, diverse and silica-rich rocks, and relatively thick and low-velocity crustal structure. Its isolation from Australia and large area support its definition as a continent—Zealandia. Zealandia was formerly part of Gondwana. Today it is 94% submerged, mainly as a result of widespread Late Cretaceous crustal thinning preceding supercontinent breakup and consequent isostatic balance. The identification of Zealandia as a geological continent, rather than a collection of continental islands, fragments, and slices, more correctly represents the geology of this part of Earth. Zealandia provides a fresh context in which to investigate processes of continental rifting, thinning, and breakup.

(The Geological Society of America / GSA Today / Volume 27 Issue 3 (March/April 2017), http://www.geosociety.org/gsatoday/archive/27/3/article/GSATG321A.1.htm)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΠΕΡΙΒΑΛΛΟΝ

Παράπονα για ζέστη
Στη Νορβηγία, ένα καλοριφέρ αρκεί για έναν όροφο

Ένα μόνο καλοριφέρ αρκεί για να ζεσταθεί ένας ολόκληρος όροφος στην πιο «εξελιγμένη» κατηγορία ενεργειακών κτιρίων.

Η σωστή μόνωση των σπιτιών για την εξοικονόμηση ενέργειας και τη μείωση των εκπομπών αερίων του θερμοκηπίου αποτελεί πλέον τον κανόνα σε πολλά κράτη, όμως στη Νορβηγία έχει αναχθεί σε άλλα επίπεδα.

Στην ψυχρή χώρα του Βορρά οι ενεργειακές προδιαγραφές πολλών νέων κτιρίων είναι εξαιρετικά υψηλές και, όπως φαίνεται, όχι απλώς αποδίδουν, αλλά μερικές φορές το... παρακάνουν, αφού πολλοί Νορβηγοί παραπονούνται ότι στους εσωτερικούς χώρους τους επικρατεί υπερβολική ζέστη. Προσπαθώντας να βρει τη «χρυσή τομή» ανάμεσα στις σωστές δόσεις θαλπωρής και στην εξοικονόμηση ενέργειας μια ομάδα επιστημόνων μελέτησε το ζήτημα και κατέληξε σε μάλλον εντυπωσιακά αποτελέσματα. Διαπίστωσε ότι στα κτίρια που έχουν πάρα πολύ καλή μόνωση ένα μόνο καλοριφέρ είναι αρκετό για να ζεστάνει έναν ολόκληρο όροφο!

Τα «παθητικά σπίτια»

Η μελέτη εστιάστηκε συγκεκριμένα στην πιο «εξελιγμένη» κατηγορία ενεργειακών κτιρίων, η οποία είναι γνωστή ως «παθητικά σπίτια» ή «κτίρια μηδενικών εκπομπών» (zero-emissions buildings - ZEB). Τα κτίρια αυτά είναι «υπερμονωμένα», με αποτέλεσμα να μειώνουν θεαματικά τόσο την κατανάλωση ενέργειας όσο και την απόδοση του συστήματος θέρμανσης. Οι ερευνητές από το Νορβηγικό Πανεπιστήμιο Επιστήμης και Τεχνολογίας (NTNU) και το SINTEF, το μεγαλύτερο ανεξάρτητο ινστιτούτο ερευνών της Σκανδιναβίας, θέλησαν να εξετάσουν ενδελεχώς όχι μόνον τις ενεργειακές επιδόσεις των παθητικών σπιτιών που έχουν κατασκευαστεί σύμφωνα με τα πρότυπα κτιρίων μηδενικών εκπομπών που ισχύουν στη Νορβηγία (αυτά περιλαμβάνουν μεταξύ άλλων μόνωση εξαιρετικά υψηλών προδιαγραφών και μειωμένο αριθμό καλοριφέρ) αλλά και το κατά πόσο οι κάτοικοί τους ήταν ευχαριστημένοι με την «εσωτερική» θερμοκρασία τους.

«Στόχος μας ήταν να βρούμε μια καλή ισορροπία ανάμεσα στην ενεργειακή απόδοση και στην ικανοποίηση των χρηστών με τη θερμοκρασία και την άνεση» δήλωσε σε δελτίο Τύπου ο Λοράν Ζορζ, καθηγητής στο Τμήμα Μηχανικών Ενέργειας του NTNU. «Με ένα μόνο καλοριφέρ ανά όροφο θα περίμενε κανείς ότι οι χρήστες θα ένιωθαν ότι στα δωμάτια όπου δεν υπάρχει καλοριφέρ κάνει κρύο, όμως διαπιστώσαμε το αντίθετο. Η γενική θερμική άνεση στους κατοικημένους χώρους ήταν καλή. Το πρόβλημα ήταν περισσότερο ότι όσοι προτιμούν το υπνοδωμάτιό τους να είναι κρύο θεωρούσαν ότι τα υπνοδωμάτια ήταν πολύ ζεστά».

Απλή κατανομή θερμότητας

Οι επιστήμονες μελέτησαν δύο διαμερίσματα και δύο κτίρια κατοικιών με μεσοτοιχία κατασκευασμένα σύμφωνα με τα νορβηγικά πρότυπα για τα κτίρια μηδενικών εκπομπών. Αρχικά έκαναν μετρήσεις για να καταγράψουν τη θερμοκρασία των ροών αέρα και του περιβάλλοντος στους χώρους κάθε κτιρίου, καθώς και την επαγωγή αέρα και την ανάκτηση θερμότητας σε αυτούς, ενώ επίσης πήραν συνεντεύξεις από τους κατοίκους. Στη συνέχεια έκαναν προσομοιώσεις των κτιρίων στον υπολογιστή ώστε να προσαρμόσουν τη θερμοκρασία με τον καλύτερο δυνατό τρόπο και έτσι ώστε να ικανοποιούν τις επιθυμίες των κατοίκων σε όλα τα δωμάτια.

Η μέθοδος θέρμανσης που επέλεξαν να εφαρμόσουν είναι γνωστή ως απλή κατανομή θερμότητας. Και, όπως διαπίστωσαν, αυτή επετεύχθη απολύτως ικανοποιητικά με ένα καλοριφέρ ανά όροφο - σε συνδυασμό με ένα καλά ρυθμισμένο σύστημα εξαερισμού. «Ο σχεδιασμός των παθητικών σπιτιών απαλλάσσει από τα ρεύματα που μπαίνουν από τα παράθυρα και από τις κρύες εξωτερικές επιφάνειες των τοίχων. Έτσι, δεν χρειάζεται να βάλει κάποιος ένα καλοριφέρ μπροστά σε κάθε παράθυρο. Μάλιστα, επειδή η τροφοδοσία του αέρα είναι μελετημένη ώστε να κατανέμει περισσότερο ομοιόμορφα τη θερμοκρασία σε όλους τους χώρους, χρειάζεται μόνο ένα καλοριφέρ για πολλά δωμάτια ή ένα καλοριφέρ ανά όροφο».

Ζέστη στο υπνοδωμάτιο

Τα παθητικά σπίτια για ορισμένους έχουν ωστόσο ένα μειονέκτημα, και αυτό είναι ακριβώς η ομοιόμορφη κατανομή της θερμοκρασίας σε όλους τους χώρους. «Πολλοί συμμετέχοντες στη μελέτη μας παραπονέθηκαν ότι τα υπνοδωμάτιά τους ήταν πολύ ζεστά. Οι Νορβηγοί συνήθως θέλουν κρύα υπνοδωμάτια, κάτω από τους 16 βαθμούς. Και αυτό δεν γίνεται χωρίς να ανοίξει κάποιος το παράθυρο, ακόμη και αν έχει κλειστή την πόρτα της κρεβατοκάμαρας όλη την ημέρα» εξήγησε η Μαρία Χούστο-Αλόνσο από το SINTEF. «Δυστυχώς, αυτός ο τρόπος ρύθμισης της θερμοκρασίας του δωματίου (σ.σ.: το άνοιγμα του παραθύρου) έχει σημαντικές επιπτώσεις στις ανάγκες θέρμανσης ολόκληρου του σπιτιού».

Οι ερευνητές μελέτησαν διάφορες στρατηγικές ώστε να προσαρμόσουν τη θέρμανση στα διάφορα δωμάτια, αλλά όπως είδαν κάτι τέτοιο δεν είναι εύκολο να επιτευχθεί. Στο παρόν στάδιο της έρευνάς τους προσπαθούν να βρουν τρόπους ώστε να μπορεί να μειωθεί η θερμοκρασία στα υπνοδωμάτια, χωρίς να αυξάνεται η συνολική κατανάλωση ενέργειας του σπιτιού. Παράλληλα ωστόσο κάποιες πρόσφατες μελέτες δείχνουν ότι αυτού του είδους η κεντρική θέρμανση αποτελεί μάλλον την καλύτερη επιλογή στα κτίρια που προορίζονται για γραφεία.

(Λαλίνα Φαφούτη / Βήμα Science / Newsroom ΔΟΛ, 3 Φεβ. 2017, http://news.in.gr/science-technology/article/?aid=1500128067&ref=newsletter)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

The Future of Construction: Mushroom Buildings

The future of construction is rotten. The process which has long been known to decompose and recycle organic matter may soon provide the building blocks to construct our future. The technology is owed to nonother than the mushroom- or more accurately, fungus.

Fungi have dominated the world's undergrowth for **millions of years**. Their unique ability to decompose organic matter enables them to thrive from the life of other organisms. Over decades of research and development, scientists are narrowing in on technologies which will allow engineers to use fungus as the main building material in future constructions.

Molding the future with fungus

The visible portion of a fungus, or a mushroom, only represents a minute fraction of the fungus. Beneath the surface, mushrooms can quickly grow out thread-like roots called **mycelium**. In recent years, scientists have developed ways to make use of the web-like formations to create many materials, including bricks.

An architectural team known as The Living designed the world's first mushroom brick tower back in 2014. The team constructed the bricks entirely from fibrous fungi which grew from agricultural waste. The idea came from Ecovative, a research company who develops alternate uses for mushroom mycelium.

The Living collaborated with structural engineers to design a building made entirely from mushrooms. The team spent weeks investigating which techniques worked best to support the most weight.

After rigorous testing, the team decided to take on the task of building a structurally sound 40-foot tower. The tower consisted of 10,000 bricks and reached 40-feet into the air.

Building a 40-Foot tower made of living mushroom bricks

The bricks used to construct the building were grown in three separate molds. To make the bricks, researchers filled molds with organic matter infused with spores. It only takes five days for the mushrooms to transform the organic matter into a viable brick, making the process cheap and efficient. Although it is not the same as conventional building materials, the early stages of mycelium material engineering are proving hopeful.

How does it compare?

As with most emerging technologies, to become a viable alternative to conventional building materials, the mushroom brick will still require extensive research and development. In essence, the brick is not as strong and does not have a long useful lifespan in comparison to most building materials.

One of the most commonly used construction materials is concrete. Concrete on its own maintains a compressive strength of concrete 4000 psi (28 MPa), up to 10,000 psi (70 MPa) depending on the requirements. Comparatively, the mushroom bricks can only withstand 30 Psi, or 0.2 MPa.

Though it cannot support nearly as much weight, it is also much lighter than concrete. The mushroom brick weighs an astonishing 43 kg/m³. On the other hand, concrete weighs about 2,400 kg/m³. Despite the brick's lack of compressive strength, its low density makes it useful in areas which do not need as much support. The bricks can be used as a both an insulator and as support for interior walls within a building.

The bricks are also surprisingly durable. Before being used to construct the 40-foot tower, engineers put the bricks under accelerated aging- a process which stimulates three years of weathering (wind, rain, and humidity) over a three-week period.

"After three years of accelerated aging the material performed exactly the same as it did originally," says David Benjamin, on of the coordinators at The Living.

https://www.youtube.com/watch?v=8G2tQ_0AiqY

Other Applications

The applications mushrooms reach far beyond that of just building applications.

Large companies are looking to mycelium as an alternative to conventional packaging materials. The mushroom packaging is naturally fire resistant and it can be easily molded to any shape. With a curing time of only five days, the mushroom manufacturing process is proving to be a viable option for other cooperations to consider.

Of course, the largest driving force behind mushroom materials is its environmental friendliness. It is carbon neutral and if exposed to living organisms, it can be decomposed.

The technology behind mushroom engineering is still in its infancy. As more carbon taxes are inevitably imposed with the increasing threat of global warming, humanity will be required to take alternative measures to save money now, and save the planet later.

(Maverick Baker / INTERESTING ENGINEERING, January 30, 2017, http://interestingengineering.com/future-construction-mushroom-buildings)

Η απογείωση της αρχιτεκτονικής

«Πεταγόμαστε» στα ωραιότερα αεροδρόμια του κόσμου μέσα από τις σελίδες του νέου coffee table book «The Art of the Airport: The World's Most Beautiful Terminals»

1. Carrasco International Airport, Μοντεβιδέο

Θεωρείται ένα από τα πιο φιλικά προς τον ταξιδιώτη αεροδρόμια του κόσμου και είναι εξαιρετικά ευρύχωρο, έτσι ώστε να κυκλοφορούν άνετα τόσο οι επιβάτες όσο και «οι φίλοι και συγγενείς τους», οι οποίοι στην Ουρουγουάη «ακόμα έρχονται να σε αποχαιρετήσουν όταν φεύγεις ή να σε υποδεχτούν όταν έρχεσαι από κάποιο ταξίδι», όπως αναφέρει χαρακτηριστικά ο αρχιτέκτονας Rafael Vinoly. Με σήμα κατατεθέν το θεόρατο καμπυλωτό στέγαστρο των 4.000 τ.μ. (!), το Carrasco διαθέτει ξεχωριστά επίπεδα για τις αφίξεις (ισόγειο) και τις αναχωρήσεις (πρώτος όροφος) και είναι κατασκευασμένο έτσι ώστε το φυσικό φως να διαχέεται ανεμπόδιστα στους κοινόχρηστους χώρους, ενώ το εστιατόριό του προσφέρει στους επισκέπτες εντυπωσιακή θέα στον αεροδιάδρομο. www.aeropuertodecarrasco.com.uy

2. Pulkovo Airport, Αγία Πετρούπολη

Ξεκίνησε να λειτουργεί τη δεκαετία του 1930, όταν η Αγία Πετρούπολη λεγόταν Λένινγκραντ και το αεροδρόμιό της Shosseynaya. Από τις παλιές εγκαταστάσεις ξεχωρίζει ο τερματικός σταθμός Pulkovo-1, του 1973, που θεωρείται αριστούργημα της σοβιετικής μεταμοντέρνας αρχιτεκτονικής. Η νέα εποχή για το αεροδρόμιο της Αγίας Πετρούπολης, όμως, επικεντρώνεται στο ολοκαίνουργιο –μόλις τριών ετών– Terminal 1, που σχεδιάστηκε από τη βρετανική φίρμα Grimshaw, η οποία εμπνεύστηκε από την αρχιτεκτονική της ίδιας της πόλης: έτσι, οι χρυσοί τρούλοι των ναών και η γεωμετρία των σοβιετικών αστεριών που συναντά κανείς σε μια βόλτα του στους δρόμους της Πετρούπολης λειτούργησαν ως αρχέτυπο για την εντυπωσιακή επιχρυσωμένη οροφή με τις αιχμηρές απολήξεις του νέου τερματικού σταθμού. www.pulkovoairport.ru

3. Spaceport America, Νέο Μεξικό

Εδώ δεν έχουμε να κάνουμε με έναν απλό αερολιμένα, αλλά για το πρώτο κοσμοδρόμιο «μαζικής χρήσης». Το Spaceport America έχει διπλό σκοπό. Αφενός φιλοξενεί σκάφη όπως είναι το SpaceShip Two της Virgin Galactic, ένα διαστημόπλοιο χωρητικότητας οκτώ ατόμων κατασκευασμένο για διαστημικό τουρισμό. Και αφετέρου προσφέρει τη δυνατότητα στους επισκέπτες να ξεναγηθούν στη διαστημική βάση και να βιώσουν εμπειρίες όπως αυτή που προσφέρει ο εξομοιωτής G-Shock, όπου μέσα από μια διαδικασία ταχύτατης επιτάχυνσης τους κάνει να αισθάνονται όπως ένας αστροναύτης εν ώρα πτήσης. http://spaceportamerica.com

4. Franz Josef Strauss Airport, Μόναχο

Με έμβλημά του ένα κεφαλαίο Μ, το δεύτερο σε επιβατική κίνηση αεροδρόμιο της Γερμανίας έχει κερδίσει, μεταξύ άλλων, την υψηλότερη διάκριση («5 star airport») της Skytrax, η οποία απονέμεται στα κορυφαία αεροδρόμια του κόσμου. Το αεροδρόμιο του Μονάχου πήρε το όνομά του από τον πρώην κυβερνήτη της Βαυαρίας Franz Josef Strauss και προσφέρει καθημερινές ξεναγήσεις σε όσους επισκέπτες θέλουν να έρθουν πιο κοντά στη συναρπαστική καθημερινότητα ενός αερολιμένα, μέσω μιας διαδρομής μήκους 12 χλμ., η οποία περνά από τους αεροδιαδρόμους μέχρι και από τα υπόστεγα συντήρησης των αεροσκαφών. www.munich-airport.de

5. Madrid Barajas, Μαδρίτη

Στα μέσα της περασμένης δεκαετίας, στους τερματικούς 1, 2 και 3 του διεθνούς αερολιμένα της Μαδρίτης προστέθηκε και ένας τέταρτος. Με δυνατότητα διαχείρισης 70 εκατ. επιβατών τον χρόνο, το Terminal 4 εκτείνεται σε δύο κτίρια, τα οποία συνδέονται μεταξύ τους με υπόγειο συρμό σε μια διαδρομή που διαρκεί 3 λεπτά. Ο τερματικός σταθμός φέρει την υπογραφή της φίρμας Richard Rogers Partnership και έχει κερδίσει το Stirling Prize, το σημαντικότερο αρχιτεκτονικό βραβείο του Ηνωμένου Βασιλείου. Η κατασκευή ξεχωρίζει για το κυματιστό μπαμπού στέγαστρο, αλλά και για το φωτεινό, όμορφο και λειτουργικό εσωτερικό, με επαρκή σήμανση, έτσι ώστε να μη χάνουν τον προσανατολισμό τους οι επισκέπτες παρά το μεγάλο μέγεθος του αεροδρομίου. www.aeropuertomadrid-barajas.com

6. Kansai International Airport, Οσάκα

Βρίσκεται στον κόλπο της Οσάκα, στην Ιαπωνία, και η δημιουργία του τράβηξε αμέσως τα φώτα της δημοσιότητας, καθώς είναι χτισμένο πάνω σε ένα τεχνητό νησί. Η αρχιτεκτονική σύλληψη ανήκει στον Ιταλό Renzo Piano και παρά το γεγονός ότι άντεξε δύο καταστροφικά χτυπήματα της φύσης –τον φονικό σεισμό του Kobe το 1995 και τον ισχυρό τυφώνα που πέρασε το 1998 με ταχύτητα που άγγιξε τα 200 χλμ./ώρα– έχει και αυτό ένα τρωτό σημείο. «Αχίλλειος πτέρνα» του αποδείχθηκε το μαλακό έδαφος, εξαιτίας του οποίου παρατηρούνται φαινόμενα καθίζησης του νησιού. Οι εργασίες συντήρησης για τον περιορισμό γίνονται μεν, είναι όμως εξαιρετικά δαπανηρές. www.kansai-airports.co.jp

7. Shenzhen International Airport, Σέντζεν

Ο μεγάλος Ιταλός αρχιτέκτονας Massimiliano Fuksas και το γραφείο Knippers Helbig Advanced Engineering, που ειδικεύεται στις προσόψεις κτιρίων, ένωσαν τις δυνάμεις τους προκειμένου να δημιουργήσουν το εντυπωσιακό Terminal 3, που πριν από τρία χρόνια αντικατέστησε τους τερματικούς σταθμούς Α, Β και D του διεθνούς αεροδρομίου Shenzhen στην Κίνα. Από ψηλά μοιάζει με τεράστιο διαβολόψαρο (σαλάχι μάντα), ενώ η κατασκευή του ξεχωρίζει για την κυψε-

λοειδή επιφάνεια από γυάλινα και μεταλλικά πάνελ που επιτρέπουν στο φυσικό φως να εισχωρεί στο κτίριο. http://eng.szairport.com

INFO: Το βιβλίο *«The Art of the Airport: The World's Most Beautiful Terminals»* των Laura Frommberg, Stefan Eiselin, Alexander Gutzmer κυκλοφορεί από τις εκδόσεις Frances Lincoln. Η τιμή του στο Amazon είναι 27 ευρώ.

(Ελευθερία Αλαβάνου / Η ΚΑΘΗΜΕΡΙΝΗ, 20 Φεβ. 2017, http://www.kathimerini.gr/896902/gallery/ta3idia/me-aformh/h-apogeiwsh-ths-arxitektonikhs)

5 Engineering Marvels You Need to See Before It's Too Late

Humans have been constructing and building engineering marvels since we were first on this Earth. While many haven't lasted, there are many others that have survived to present day. Some of the most amazing surviving structures across the globe are in danger of being destroyed due to environmental factors. Here are **5** of those engineering marvels that you need to see. . . before it's too late.

Venice, Italy

Venice is arguably one of the most beautiful cities in the world. It is built on 118 tiny islands with engineered waterways throughout. As continents have shifted and water levels have risen across the globe, Venice is in serious danger of getting destroyed. There are currently multibillion-dollar plans to install floodgates, but the efforts may be too little too late. Heavy storms continue to berate the city that was

called the most beautiful city in the world in 1495 by French King Charles VIII. The city remains as one of the engineering marvels with the implementations of piers and beams over water construction. If you hope to one day see the city, now may be the time to book a trip.

Taj Mahal

The Taj Mahal may be the most iconic monument in the world, but it too may not be around for much longer. The monument was built after Emperor Shan Jahan's wife, Mumtaz Mahal, died in childbirth in 1631. The white temple features a 187-foot dome with a reflecting pool in the front. The white marble on the monument has been deteriorating heavily for many years. in the 1990s, the Indian government began restoration work. For now, it would appear that the massive wonder is safe, but given it's all stone construction and old age, it could be destroyed from its current state through a number of environmental disasters.

Easter Island

Easter Island, while not commonly thought of as a feat of engineering, is one nonetheless. 2,000 miles of the coast of South America sits this historic island littered with buried heads – and subsequent bodies attached. Discovered in 1722, historians and archaeologists still are uncertain how the stone heads arrived on the island in the first place. Each head and body average 13 feet tall with a weight of 14 tons. The engineering marvel behind the island is just how these structures were put in place by such an isolated population. Climate change and rising tides have a real possibility of destroying the historic island. If tides were to rise above the statues, it would only take a matter of years for their details to be wiped away.

Ephesus

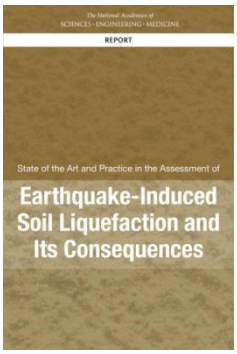
Ephesus remained one of the most vibrant metropolises of the ancient world for hundreds of years. The city is located on the current western coast of Turkey, and in its height, 300,000 people lived there. One of the biggest reasons Ephesus has worked its way into modern history is the Temple of Artemis that still remains there today. It is one of the seven wonders of the ancient world. Today, the temple remains in a state of ruin, but to a degree that has relatively preserved its beauty. Weathering from storms presents a very real threat to the survival of the temple, and it's something you need to see before it becomes a pile of rubble.

Macchu Picchu

Machu Picchu is one of the engineering marvels that takes some effort to witness. Perched atop the Huayna Picchu Mountain, it looms 1,000 feet above terraces and stonework that curl up from the river below. The ancient city was an agricultural mecha, one completely decided on steep facades of the mountain. Ancient engineers undertook an impressive task as they stabilized the mountain side with stones and soil compaction. They took extra effort to manage irrigation channels in the city, which ultimately served as the royal retreat for the Incan emperor of Pachacuti. Visiting Machu Picchu is actually what might destroy it. Influxes of tourists to the area have destroyed much of the support and stonework and it is now at risk of major destruction. If you want to visit this site, be committed to preserving its wonder.

(Trevor English, February 28, 2017, http://interestingengineering.com/5-engineering-marvels-need-see-before-late)

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



Earthquake-Induced Soil Liquefaction and Its Consequences

National Academies of Science, Engineering & Medicine

The National Academies of Science, Engineering & Medicine (NASEM) recently released a report of high value for the engineering community on the "State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction and Its Consequences". The report aims to help the technical community reach again consensus on issues related to liquefaction triggering assessment and build confidence in methods used to assess liquefaction initiation and its consequences.

The report focuses on developments since the 1996 and 1998 National Science Foundation/National Center for Earthquake Engineering Research (NCEER) workshops, where consensus was last reached on the topic of assessing liquefaction triggering. A committee of 12 engineers and scientists thoroughly evaluates the following: the sufficiency, quality, and uncertainties associated with laboratory and in situ field tests, case history data, and physical model tests for understanding liquefaction triggering and post-triggering soil behavior; methods to analyze the data from those tests; and the adequacy and accuracy of empirical and mechanistic methods to evaluate triggering and resulting deformations in the soil and the structures built in, on, and of those soils. The report considers future directions for research and practice, coming with a number of recommendations in the end.

In a brief overview, the report deals with the following:

- Provides a description of the phenomena associated with earthquake - induced soil liquefaction and the factors influencing them;
- Discusses the sufficiency of the case history data on liquefaction and associated phenomena, including field case histories, and provides a critical assessment of those data;
- Describes and assesses the simplified stress - based approach to predict the initiation of liquefaction;
- Assesses alternative approaches to liquefaction triggering assessment such as strain - based, energy - based, and computational mechanics - based approaches;
- Describes the assessment of the post - liquefaction shear strength of soils;
- Discusses empirical and semi - empirical methods to evaluate liquefaction consequences;
- Discusses how computational mechanics can be used to predict liquefaction triggering and consequences;
- Discusses performance - based engineering methods for probabilistic evaluation of liquefaction susceptibility, triggering, and consequences;
- Provides committee recommendations for advancing the state of practice and state of the art for assessment of earthquake - induced soil liquefaction.

(2016, https://www.nap.edu/catalog/23474/state-of-the-art-and-practice-in-the-assessment-of-earthquake-induced-soil-liquefaction-and-its-consequences)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

Κυκλοφόρησε το Τεύχος # 1 του Τόμου 11 του ISSMGE Bulletin (Φεβρουαρίου 2017) με τα ακόλουθα περιεχόμενα:

- President's message

- Major project

Hong Kong Visionary Plan in the Pursuit of Rock Cavern Development

- Young members' arena

- Conference reports

International Workshop "Geotechnical and structural problems associated with the protection of historical monuments and unique constructions"

The 8th Asian Young Geotechnical Engineers Conference

- ISSMGE Foundation report

- Obituary

Professor Fukuoka, Past President of ISSMFE

- Event Diary

- Corporate Associates

- Foundation Donors

www.geoengineer.org

Κυκλοφόρησε το Τεύχος #142 του **Newsletter του Geoengineer.org** (Φεβρουαρίου 2017) με πολλές χρήσιμες πληροφορίες για όλα τα θέματα της γεωμηχανικής. Υπενθυμίζεται ότι το Newsletter εκδίδεται από τον συνάδελφο και μέλος της ΕΕΕΕΓΜ Δημήτρη Ζέκκο (secretariat@geoengineer.org).

Ενδεικτικά αναφέρονται:

- Sinking and tilting of San Francisco's Millennium Tower has led things to courts
- Damage to California's Oroville Dam forces mass evacuation under the threat of flooding
- Ancient submarine landslide discovered at the Great Barrier Reef in Australia (video)
- Bogoslof island has tripled in size after volcano's continuing eruptions
- New Champlain Bridge construction: A project milestone for Canada (video)
- Public release of the NASEM Report on Liquefaction Assessment
- Landslide crumbles down San Bernardino County's mountain in California (video)
- Sea cliff collapses due to lava flow from Hawaii volcano (video)
- BRACE project aims to build resilience against earthquakes in Bhutan

http://campaign.r20.constantcontact.com/render?m=1101304736672&ca=80daf423-9af2-47f8-a77d-ac4842132e2e

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2015 – 2018)

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