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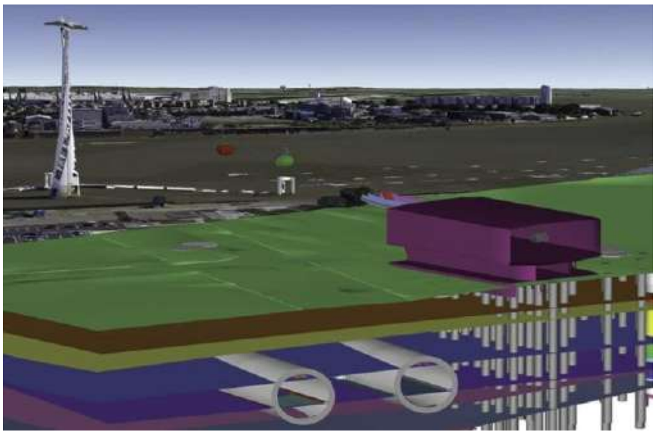
Combining geological modelling and BIM for infrastructure

HoleBASE SI and AutoCAD Civil 3D help Atkins design a new tunnel under London's River Thames



Transport for London (TfL) — the statutory authority responsible for most aspects of Greater London's transports system — plans a new road tunnel under the River Thames in East London. The proposed Silvertown Tunnel between Silvertown and North Greenwich will ease the strain on the nearby Blackwall Tunnel and other existing crossings. Engineering and design consultancy Atkins developed the project's reference design.

The battleground

The south portal of the tunnel route is the site of a demolished gas works. The soil in that area is contaminated and there are still remnants of the underground foundations of the plant. On the south and north banks, the proposed tunnel location comes close to the pylon foundations of the Emirates Air Line cable car. Additionally, the North bank tunnel portal is in the area of the now-filled western entrance to the Royal Victoria Dock and some demolished warehouses — there are still underground remnants of these features.

"The tunnel on both sides of the river will need to thread through heavily industrialized areas of London, with a myriad of existing soil types, roads, foundations, and other subsurface structures, as well as subsurface remnants of demolished structures," explains Simon Miles, a principal geotechnical engineer with Atkins. He adds, "To reduce the overall project cost and risk, we needed ways to better see and understand subsurface soil conditions in the context of existing built conditions, and calculate earthwork quantities and areas that will be impacted by construction." The increased costs of treating contaminated materials makes accurate volume calculations vital for assessing cost implications.

> *The use of a fully integrated, multidisciplinary Civil 3D model, including subsurface geology, has been a real eye-opener for the team. By visualizing ground conditions in a design context, we can reduce project risk and project costs during construction*
> ***Simon Miles***
> *Principal Geotechnical Engineer, Atkins*

Upgrading the mechanism

For many years, Atkins has been using AutoCAD Civil 3D from Autodesk for civil engineering design and documentation, and HoleBASE SI from Keynetix for geotechnical knowledge management. For its preliminary design of the Silvertown Tunnel, the firm used the HoleBASE SI Extension for AutoCAD Civil 3D to quickly visualize geotechnical data in the model-based, multidisciplinary Civil 3D environment.

"With the HoleBASE SI Extension for Civil 3D, we could quickly combine, organize, and manage geology data, and then see that data in the context of existing and proposed above and below-ground structures," says Jerome Chamfray, an Atkins BIM Manager. "This helped us visually understand and evaluate the design alignment, pinpoint potential construction obstructions, and determine what new site investigations were needed." Moreover, Atkins used Civil 3D to automatically generate earthworks quantities for project costing and risk assessment.

Geological modeling and BIM

Atkins planned its ground investigation by importing historical data [from previous Atkins projects in the same area and British Geological Survey data] into HoleBASE SI to determine requirements for new borehole data. "By reusing this historical data in HoleBASE SI, we significantly reduced the amount of exploratory holes that were required on-site, which translated into reduced project time and cost for our client," says Miles. After completing the on-site ground investigation, the data was merged with the historical information in HoleBASE SI for engineering interpretation and stratum identification.

In parallel, the firm used Civil 3D to create an existing conditions model of the project area [both above and below the surface] based on a variety of data sources such as TfL's as-built data for the cable car foundations, and historical data for the demolished gas works foundations, ware- houses, and piers and foundations of the old dock entrance. Next, Atkins added the proposed tunnel alignment and oth- er proposed structures relating to the tunnel.

The firm then used the HoleBASE SI Extension for Civil 3D to automatically layer the geotechnical data into the Civil 3D model. This enabled Atkins engineers to visualize the geotechnical data in relation to the existing site and proposed design. "Having a live link between the HoleBASE SI database and Civil 3D dramatically improved our design process," says Chamfray. "Whenever the HoleBASE SI database was updated, those changes were automatically reflected in the Civil 3D model and we didn't have to waste time recreating or manually synchronizing the geotechnical data in Civil 3D, which gave us more time to refine and improve our design."

Atkins also used Civil 3D to extract volumes for the different materials that will be excavated. "We were able to identify areas that will require specific treatment on-site during excavations, such as the treatment of hazardous material for example," says Miles. "This gave us a clearer picture as to what material could be reused for construction and helped us refine our cost estimate."

Production of geological sections and other inter-disciplinary checks were also facilitated by having all the information in a common data environment. "The Civil 3D model helped us maximize efficiency and increase our level of design confidence," says Miles. "This 3D design environment allowed us to visualize the subsurface conditions in a new way — giving us a better understanding of the site for more informed decision-making."

For example, the original design for the road as it entered one of the portals placed the road's ground slab below the local water table level, which would have led to a continuous flow of ground water into the tunnel. "With the ground slab and the geological model in the same 3D environment, we could easily see and quickly make the necessary design changes," says Miles. Atkins also used the Civil 3D project model in Autodesk Navisworks for client and partner design reviews and walkthroughs, and in Autodesk 3ds Max to create high-end project renderings for TfL's public outreach efforts.

Success cornerstone

"The HoleBASE SI Extension for Civil 3D streamlined the flow of information from our site investigation and testing to drawing production and visualization," says Chamfray. "As a result, we had more time to refine our design and were more responsive to changes from new geotechnical data."

"The use of a fully integrated, multidisciplinary Civil 3D model, including subsurface geology, has been a real eye-opener for the team," says Miles. "By visualizing ground conditions in a design context, we can reduce project risk and project costs during construction."

(Gary Morin / GEOSPATIAL WORLD / November 9, 2016, https://www.geospatialworld.net/article/geological-modelling-and-bim-infrastructure)

Prof. John Burland in YouTube

World-leading geotechnical engineer Professor John Burland introduces viewers to the world of soil mechanics. This is the first in the Bare Essentials of Soil Mechanics series: the key things a civil engineer needs to created to understand about soil mechanics. More engineering teaching resources available on http://expeditionworshed.org

Prof Burland is based at Imperial College London and has worked on hundreds of interesting projects, the most famous of which was stabilising the Leaning Tower of Pisa. In this video Prof Burland invites us to spare a thought for the long-forgotten geotechical engineer whose responsibility it was to stop the tunnels from falling on our heads or to prevent the skyscrapers from sinking into the ground. He goes on to describe soil mechanics as the branch of science that studies the mechanical behaviour of soils as they apply to the design of civil engineering structures.

Learning outcomes

This video will help learners answer questions such as:

What is geotech engineering?

What is the relationship between civil engineering and geotechnical engineering?

What does a geotech engineer do?

In what civil engineering projects do geotechnical engineers get involved?

What is soil mechanics?

About the Bare Essentials of Soil Mechanics Series

This video is part of the Bare Essentials of Soil Mechanics series, funded by the Ove Arup Foundation, in which Professor John Burland draws on his many years of practice in geotechnical engineering and teaching to provide listeners with what he regards to be the key knowledge that geotechnical engineers need to understand about soil mechanics in engineering practice.

1 **What is soil mechanics?**
https://www.youtube.com/watch?v=ZuofAC9rq58&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

2 The Particulate Nature of Soil
https://www.youtube.com/watch?v=mB3O6hQAoZA&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6&index=2

3 **The Effect of Gravity on Soil Strength**
https://www.youtube.com/watch?v=-EUQcluC-ZQ&index=3&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

4 **The Effect of Particle Size and Strength on Soil Strength**
https://www.youtube.com/watch?v=qY_PRCmg85E&index=4&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

5 **The Effect of Water on Soil Strength**
https://www.youtube.com/watch?v=a-6YbkZJ5UY&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6&index=5

6 Civil engineering: An oral history part 1 - Engineering heroes
https://www.youtube.com/watch?v=C8K8cDZzbPc&index=6&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

7 **Civil engineering: An oral history part 2 - Propping up Pisa**
https://www.youtube.com/watch?v=04MbizZtHak&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6&index=7

8 **Civil engineering: An oral history part 3 - Parking under Parliament**
https://www.youtube.com/watch?v=6eknBQucHT4&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6&index=8

9 **Civil engineering: An oral history part 4 - A career in civil engineering**
https://www.youtube.com/watch?v=g7TDXKAZpP8&index=9&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

10 **The Soils of London**
https://www.youtube.com/watch?v=t4vZ9ojOOw0&index=10&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

11 **Professor John Burland Is Concerned About The Leaning Tower of Pisa Falling By Earthquake!**
https://www.youtube.com/watch?v=mvOPg5PBP0E&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6&index=11

12 **The Enigma of the Leaning Tower of Pisa - 1998 Buchanan Lecture by John B. Burland**
https://www.youtube.com/watch?v=hGVYZ6uaGGU&index=12&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

13 **On the Inside The Leaning Tower of Pisa**
https://www.youtube.com/watch?v=3gTq4WggLp0&index=13&list=PLm_XdL5VWE_uADbL7Mf2hJVlKkCZWuwP6

Prof. Evert Hoek in YouTube

1 **Development of Rock Engineering**
https://www.youtube.com/watch?v=r0ezG4SmaXM&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=1

2 **The Art of Tunnelling in Rock**
https://www.youtube.com/watch?v=RDDoBECOUf4&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=2

3 **Intact Rock Sampling and Testing**
https://www.youtube.com/watch?v=wAame7W5F50&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=3

4 **Rock Slope Engineering**
https://www.youtube.com/watch?v=1c0W01jUrRM&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=4

5 **Large Underground Excavated Caverns**
https://www.youtube.com/watch?v=fMcKpwvFTAE&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=6

6 **Evert Hoek - Tunnelling in Overstressed Rock. Eurock 2009 Lecture**
https://www.youtube.com/watch?v=fMcKpwvFTAE&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=6

7 **Dr Evert Hoek - TAC 2014 Tunneller of the Year**
https://www.youtube.com/watch?v=eVk5RkMbSRo&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=7

8 **Face to Face with Dr Evert Hoek**
https://www.youtube.com/watch?v=n46hoUmxESw&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=8

9 **Rock Mass Properties**
https://www.youtube.com/watch?v=pgIjAXKyPWY&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=9

10 **Dr. Evert Hoek: TAC 2014 Tunneller of the Year**
https://www.youtube.com/watch?v=Ll2NBUJ08Io&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=10

11 **Evert Hoek - Live at Leeds!**
https://www.youtube.com/watch?v=l6OShS4nHGc&t=0s&list=PLm_XdL5VWE_s8e_f7aeOGx9KbLmMQsgV-&index=11

ΑΡΘΡΑ

Design of Tunnel Plugs for Hydropower Projects

Chongjiang Du

Though they are an important part of the dam construction process, tunnel plugs are an oft-overlooked part of a project's design.

Diversion tunnels and access adits to power tunnels at hydropower projects must be closed with concrete plugs prior to initial reservoir impounding. The primary responsibility of these plugs is to provide a barrier against reservoir water throughout the life of the project.

Although the volume of concrete used and costs associated with the plug are insignificant in comparison to the total project costs, the plug is an important, permanent element that should receive proper consideration during a project's design. However, the schedule for plug construction is usually tight because its construction typically takes place when the project is approaching completion.

Current design practices draw upon decades of observation and practice, but there is no consistent nor unified design criteria or engineering practice for tunnel plugs. This article will draw upon the author's experience to explicate the subject, with the goal of providing guidance in the design of tunnel plugs for hydroelectric facilities.

Positioning and structural features

The positioning of tunnel plugs is primarily governed by functional and operational requirements, while economic considerations are rarely a critical factor in the decision-making process because of the limited concrete volume and related works. Some secondary factors — such as the completion schedule, access requirements, water table level and local geological conditions — could occasionally affect the positioning of the plugs.

Generally speaking though, common practices dictate that:

• For a diversion tunnel, the plug should be arranged in the abutments beneath the dam, near the dam axis;

• For permitting utilization of a diversion tunnel as a head-race, sediment sluicing or flood discharge tunnel, the plug should be located immediately upstream of the intersection of the diversion tunnel with the vertical/inclined shaft and water conductor tunnel; and

• For an access adit to the power tunnel, the plug should be arranged at the immediate junction with the power tunnel.

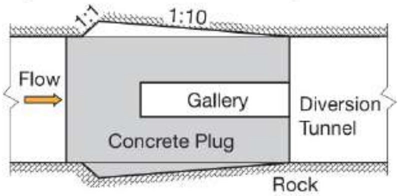
In the latter two cases, additional concrete should be placed for the necessary hydraulic profile at the junction with the main tunnels. Given the primary requirements to safely retain the reservoir, a number of concrete outlines may be chosen. In practice, two types of tunnel plugs are frequently applied at hydro facilities:

• Solid concrete plug with or without a grouting gallery (see Figure 1); or

• Gated concrete plug (see Figure 2).

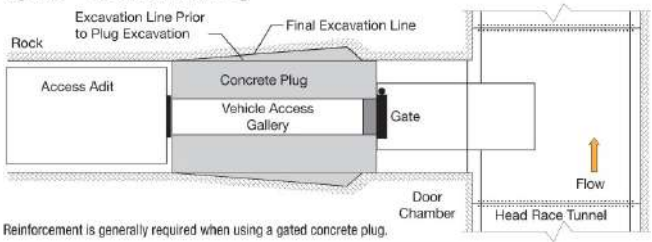
The shape of the plug, its contact with the surrounding rock and its stability are the most important design features for providing stability and favorable hydraulic conditions. For better plug action and cutting the seepage path along the concrete/rock interface, it is generally recommended to enlarge the tunnel into a conical shape with the narrow end facing downstream, then fitting it with a wedge-shaped key. Another advantage of this "bottle plug" key is that some possible minor gap at the concrete/rock interface caused by concrete shrinkage could be closed.

Figure 1 — Solid Concrete Plug



This cross-section shows a solid concrete plug, used with or without a grouting gallery.

Figure 2 — Grated Concrete Plug



Reinforcement is generally required when using a gated concrete plug.

The key should be provided at the concrete/rock interface and within concrete to ensure effective plug action by providing adequate bearing of the plug concrete on the tunnel lining or plug concrete/tunnel lining on the surrounding rock. The keyway should have a minimum depth of 0.45 m. At a minimum the key should be constructed at the bottom and side walls of the plug, in case the construction schedule is tight. For a tunnel excavated by tunnel boring machine, the depth of the key becomes a question of the required mechanical support.

For a tunnel excavated by drill-and-blast method, the key should be 1 to 2 m deeper, depending on the blasting techniques and design. The key in a diversion tunnel can be excavated before or after the diversion period, depending on the construction schedule. If the key is excavated before diversion, the keyway should be filled up with lean concrete to ensure the smooth flow of water during the diversion period. The lean concrete should be removed before placing the plug concrete.

The plug should be constructed as a monolithic structure with no transverse joint. To facilitate grouting, a gallery may be arranged in the plug. Adequate provisions should be made for dewatering during construction. The concrete plug may be placed in lifts. To ensure proper bonding between two successive lifts of concrete, chipping or roughening the joints should be performed, along with provisions for suitable dowels. For gated concrete plugs, reinforcement is generally required.

Typical design criteria for tunnel plugs

Tunnel plugs are significant engineering structures. They are characterized mechanically by their own stress states and hydraulically by water pressure and flows. The design criteria should be worked out considering both of these requirements.

Diverse design criteria are used by varying individuals and agencies, but in general plugs should be designed using the following principals and requirements. The plug:

• Is a permanent element and should be designed using the same criteria as the corresponding water-retaining structures, such as the dam or power intake;

• Should be reliable and stable during the project life;

• Should be resistant to hydrofracturing of surrounding rock;

• Should be able to prevent excessive seepage passing through the plug and adjacent rock mass;

• Should be strong enough to withstand the actual pressure; and

• Should be safe against sliding within the structure.

The concrete plug can function as a water barrier when it tightly bonds to its surrounding rock, forming an integral mass. Behavior of the plug is closely related to its surrounding rock mass. Therefore, it is necessary to thoroughly treat the surrounding rock mass and concrete/rock interface so as to get good rock conditions and to eliminate as many small water-bearing fractures as possible.

Moreover, caution is urged over the design interface between the temporary work and permanent structure because diversion tunnels and adits are designed and constructed as temporary works, whereas the concrete plug is a permanent structure. This, it is often necessary to treat the surrounding rock.

Hydrofracturing

Hydrofracturing is an event that produces fractures in a sound rock while hydrojacking or uplift by the opening of existing cracks of joints due to high-pressure water. This phenomenon is well-documented. Eliminating the risk of hydrofracturing is a fundamental task for the engineer involved in the design of tunnels and tunnel plugs. A number of criteria have been developed to guide the selection of the minimum cover to prevent hydrofracturing, of which one generally accepted is the Norwegian cover criterion.[1]

The minimum allowable depth of cover shall be as follows:

Equation 1

$$H_r = \frac{FS_{hy}\gamma_w H_w}{f_r \cos\varnothing}$$

where:

• H_r is required rock cover (m);
• FS_{hy} is factor of safety for hydrofracturing;
• H_w is static water head (m);
• γ_w is unit weight of water (kN/m³);
• f_r is unit weight of rock (kN/m³); and
• θ is slope angle of the mountain.

This equation will provide a factor of safety of 1.3 against uplift or hydraulic jacking. Checks using this equation should consider both lateral and vertical cover and make sure there are no major interconnected discontinuities or significant deformable zones near the plug.

In practice, the hydrofracturing check for the plug can be omitted in many cases. These include when the plug is located in the abutment beneath the dam (hydrofracturing will not occur) and when the plug is located in an access adit at the junction with the power tunnel (the hydrofracturing check was performed during design of the tunnel). When in doubt, the hydrofracturing check should be performed.

Determination of plug length

Determining the proper plug length is an essential part of the design work. It is unanimously accepted that the static load from water pressure can be considered as only load for the plug design. The plug should be designed for the maximum reservoir level, or the full supply level plus water hammer, depending on which is critical.

A safety factor should be designated to cover any imperfections and uncertainties in the acquisition of parameters, in construction and other rare situations. Water pressure acting on the plug, depending on the project, varies from low head (10 m) to very high head (above 1,000 m). Other actions — such as rock stresses, groundwater pressure and grouting pressure — are insignificant. Earthquake loading — even in the event of a major earthquake — is not critical for plugs deep underground of 30 to 50 m or more because the acceleration is significantly lessened and the required factor of safety is low for the transient conditions. However, seismic loads could become important if the plugs are located near the tunnel inlet or outlet in a strong seismic region. In addition, water hammer caused by major earthquakes should be checked.

Plugs should be so designed that their lengths satisfy the criteria described earlier. There are two primary categories of principals to determine the length of the tunnel plugs, namely:

• Punching shear failure mode, in which the plug should have sufficient structural capacity to carry the static load from the water pressure; and

• Hydraulic failure mode, in which the plug should satisfy the requirements in terms of hydraulic gradient within concrete, at the concrete/rock interface, and through the rock mass.

In the past, many empirical formulas were used to determine the plug length:

• Should not be less than the excavated diameter of the tunnel.[2] If the tunnel is not circular, the equivalent diameter D_{eq} should be used;

• For low head projects, should be equal to 2 to 2.5 times the excavated diameter of the tunnel used;[3]

• Should be equal to 2% to 5% times the static water head for high head projects;[4] and

• The required plug length $L_{req} = mH_wD_{eq}$, where the coefficient m=0.0125 to 0.02.

Nevertheless, the following practice is becoming more prevalent in today's designs. First, candidate lengths are calculated using the methods described below. Then, the candidate with the largest length is adopted as the final plug length. It should be noted that the finite element method is not deemed necessary to be used in the determination of plug length because of its complexity.

Hydraulic gradient

Concrete plugs are designed to provide a barrier to axial water flow. This function requires that the plug has a low hydraulic permeability. The interface between the plug and rock should be sufficiently sealed. Unfavorably oriented geological structures are avoided at the location for the plug or sealed by grouting. The maximum linear hydraulic gradient along the plug axis — that is, the ratio of water head to plug length — can be considered as a measure of leakage. Higher gradients may lead to unacceptably high leakage, piping or downstream erosion. The values can be used to determine the required plug length.

For an individual tunnel plug, the required plug length is then determined using the following formula:

Equation 2

$$L_{req} = H_w / [I]$$

Regrettably, not much attention has been paid to the hydraulic gradient requirements in the design of tunnel plugs. Thus it is strongly suggested to take into account this criterion in the design.

Shear friction along concrete/rock interfaces

The shear friction against sliding along the concrete/rock interface is a commonly accepted criterion for determining the plug length. The required length is derived on the basis of the primary principal $V_n \geq FS_{sf} \cdot V_u$, in which V_n is the shear-friction resistance of the concrete-rock interface, FS_{sf} is a factor of safety against sliding, and V_u is the water load acting on the plug.

The shear friction resistance includes two primary contributions: frictional resistance and cohesion. The frictional resistance depends on the effective weight of the concrete plug. Because the weight of the concrete plug is comparably small, it is usually neglected and taken as a safety margin. Thus the equation becomes:

Equation 3

$$L_{req} = \frac{FS_{hy} \cdot \gamma_w H_w \cdot A}{c \cdot P_u}$$

where:

• c is the cohesion intercept (kN/m²); and

• P_u is the perimeter of the plug at the concrete-rock interface in unit length in compression (m²).

• A is the cross sectional area of the plug (m²).

In practice, the factor of safety FS_{sf} = 1.5 to 3.0 has been used by various individuals and agencies. The author recommends the use of values specified by the U.S. Army Corps of Engineers,[6] with FS_{sf} = 2.0, 1.7 and 1.3 for usual, unusual and extreme load cases, respectively, the same as that for the design of gravity dams. Special attention should be paid to the perimeter of the plug P_u. Only the part of total perimeter P in compression can be taken into account in the calculation. For a tunnel with quadratic shape, the whole upper face may not be in compression and should be ruled out. If the tunnel has a circular/arch upper face, the upper 120-degree area should be subtracted.

Concrete or rock shear at plug circumferential area

The punching shear of the plug through concrete or rock mass at the plug circumferential area is another frequently used criterion for the determination of plug length:

Equation 4

$$L_{req} = \frac{FS_{sh} \cdot \gamma_w H_w \cdot A}{[\tau] \cdot P_{eff}}$$

where:

• FS_{sh} is factor of safety against shear failure;

• $[\tau]$ is design shear strength of concrete or rock mass (kN/m²), whichever is less; and

• P_{eff} is effective perimeter of the plug at circumferential area in unit length (m²).

The design shear strength of concrete can be derived from ACI-350: $\tau = 0.17\varphi \cdot \sqrt{f_c}$ and FS_{sh} = 1.4, in which f_c is the concrete compressive strength measured by crushing cylindrical concrete specimens and φ=0.75 is the strength reduction factor. The project-specific shear strength of rock mass obtained on the basis of field and laboratory tests is recommended to be used. In the absence of project-specific data, shear strength may be used. The effective perimeter of the plug depends on the construction quality, usually P_{eff} =(0.80 ~ 1.0)P.

Grouting

Grouting the surrounding rock mass and concrete/rock interface is a primary step for concrete plug construction. The purpose of grouting is to improve the quality of the rock mass, reduce seepage and leakage, prevent piping and downstream erosion, and ensure better shear friction and shear resistance by filling fissures and voids in the surrounding rock and at the concrete/rock interface.

Curtain grouting

For the plugs of diversion tunnels located beneath the dam, curtain grouting surrounding the plugs should be performed. The ring curtain grout fan should be extended to the grout curtain at the dam's foundation, forming a seepage cutoff to effectively increase the length of seepage path around the plug. This also decreases seepage passing through the rock mass.

Consolidation grouting

In poor rock mass with a high permeability, consolidation grouting should be performed to improve the bearing rock and to reduce seepage. The necessity, extent and details of the consolidation grouting should be individually determined according to the local geological conditions. Consolidation grouting should be conducted either prior to the placement of the plug concrete or after the concrete gains the required strength. The latter is preferred, if the construction schedule permits.

Contract grouting and backfilling grouting

A backfilling grouting system containing feed and return pipes, vent headers and outlets should be installed prior to placing plug concrete. Water stops should be installed at the upstream and downstream end of the plug. Through the pre-installed grouting system, the cavities in the overt area can be backfilled with a grout pressure of 3 to 5 bars at three to seven days after placing the plug concrete. It should be noted that backfilling grouting is not performed at many projects, while the cavities and voids in the overt area are filled during the contact grouting.

Regardless, the concrete plug should be contact-grouted thoroughly to ensure full contact at the concrete/rock interface. For this purpose, holes of 50 mm to 76 mm in diameter should be drilled 30 cm to 50 cm deep into rock in the crown portion. The pipes of contract grouting should be inserted into the holes and introduced into the gallery or tunnel downstream. The contact grouting should be performed prior to the initial reservoir impounding as the temperature of the plug concrete drops to a stable temperature, but at least 1.5 months after concrete placement when a post-cooling system is not installed. To reduce the lapsed time for dropping the concrete's temperature, the installation of a post-cooling system is strongly suggested.

For curtain grouting and consolidation grouting, fan holes are required to be drilled into the rock mass through concrete. The grout holes should be staggered. In addition, holes should be drilled at the downstream end of the plug to ensure that any seepage that bypasses the plug is released to the tunnel in a controlled manner.

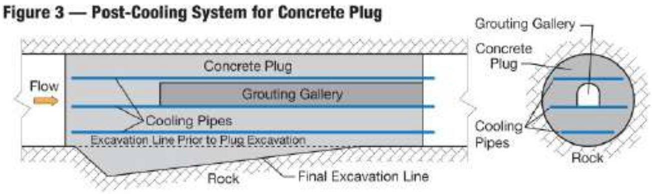
Temperature control

Because the plug concrete belongs to mass concrete, temperature control during concrete placement is necessary to determine the time when the contact grouting commences. Due to the outlines of the plug and its boundary conditions, no section-through crack may occur in transverse and longitudinal directions as demonstrated by construction practices in normal conditions. Like other mass concrete structures, the temperature control measures for the plug concrete usually include:

• Using low-heat cement and/or shrinkage-compensating concrete;
• Reducing the cement content;
• Using fly ash or other pozzolan;
• Lowering the placement temperature by pre-cooling;
• Placing concrete in low temperature seasons; and
• Post-cooling using cooling pipes embedded into the concrete.

It should be noted that the post-cooling system, as illustrated in Figure 3, is not used in most plugs, although it is preferable — especially if the pre-cooling of concrete is not carried out. Precautions should be taken due to the fact that concrete strength at an early stage will be decreased by using fly ash or other pozzolan, which may influence the construction schedule. Thermometers can be installed into the plug concrete to monitor temperature variations.

Figure 3 — Post-Cooling System for Concrete Plug



Although post-cooling systems are not used in most plugs, they are preferable — especially if the pre-cooling of concrete is not performed.

Shrinkage-compensating concrete for tunnel plugs

The application of shrinkage-compensating concrete has become increasingly more common in the construction of concrete plugs during recent years. This type of concrete is made with an expansive cement or expansive component system, which creates an autogenous volume expansion of concrete to compensate for possible shrinkage while cooling.

In this regard, magnesium oxide-based concrete is to be highlighted.[7] MgO concrete is made by adding lightly burnt MgO powder to the concrete mix, which exhibits some autogenous volume expansion that can effectively compensate for volume shrinkage while temperatures drop, and for the autogenous volume shrinkage of Portland cement itself.

With this property, the risk of gap formation at the overt of the tunnel plug is decreased or even avoided, so that the bonding of concrete to the surrounding rock and the seepage resistance is improved. As a result, the temperature control can be simplified, and post-cooling may not be necessary. Therefore, it is highly advisable to construct tunnel plugs using the shrinkage-compensating concrete.

Concluding remarks

The criteria for the design and construction of tunnel plugs are summarized. In determination of the plug length, the method and formulas provided in this article should be used. Grouting the surrounding rock and concrete/rock interface as well as temperature control for the plug concrete construction are emphasized.

Notes

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Chongjiang Du is a concrete and dams expert with Lahmeyer International GmbH.

(HYDRO REVIEW / June 2017, pp. 70-76)

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΜΗΧΑΝΙΚΩΝ

Aliki Kokkinou
(Imperial College Soil Mechanics MSc 2014)
wins the
2017 Ground Engineering Rising Star Award

I am delighted to announce that Aliki Kokkinou (MSc Soil Mechanics & Environmental Engineering 2013-2014) won the 2017 Ground Engineering Rising Star Award. Well done Aliki!!!

Winner: **Aecom**, Aliki Kokkinou

(Stavroula Kontoe, Senior Lecturer at Imperial College London)

GE AWARDS WINNERS
Rising Star Award

Winner: Aliki Kokkinou, Aecom

Aecom assistant geotechnical engineer Aliki Kokkinou's natural aptitude for mathematics and physics, combined with the fact that both her parents are engineers, led her towards a career in construction.

"I was fascinated with the idea of a profession that involves problem solving, designing and building structures of different scales, from buildings to bridges and tunnels," she says.

Kokkinou studied civil engineering at the Aristotle University of Thessaloniki and the University of Florence before doing a Masters in soil mechanics at Imperial College London.

Since joining Aecom she has worked on a wide range of geotechnical projects in London, including the Greenwich Peninsula and Thames Tideway Tunnel. She has also collaborated on a technical paper for a Crossral competition on the behaviour of a diaphragm wall at Paddington Station.

Aecom principal geotechnical engineer Mitesh Chandegra says: "Aliki continually promotes a positive culture of lessons learned and knowledge transfer by producing and sharing numerous technical notes that she produces in her own time, following delivery of these and other projects."

The judges said Kokkinou "impressed them with her passion and commitment to continue to recruit and retain the most able for the industry, particularly given the significant increase in tuition fees and the differential between salaries in geotechnics and financial institutions."

• This category celebrates emerging talent in the geotechnical industry and was open to engineers aged 30 and under who have made a significant contribution to a project, or demonstrated technical ability through research. Candidates were judged on all-round ability - not only academic and work-related achievements, but also their enthusiam for geotechnical or geoenvironmental engineering.

GE AWARDS WINNERS

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Sponsored by Bachy Soletanche

"Continually promotes a positive culture of lessons learned

Finalists

- **Riccardo Corti** Arup
- **John O'Donovan** Gavin and Doherty Geosolutions
- **Frank O'Leary** Arup
- **Martin Plant** Atkins
- **Joseph Slattery** CGL
- **Matt Walpole** Simpson Walpole

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GROUND ENGINEERING, July 2017, p. 28

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

ASIA 2018 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

ICGIMSES 2018 - 20th International Conference on Ground Improvement and Mechanically Stabilized Earth Structures, March 15 - 16, 2018, London, United Kingdom

ICGIT 2018 - 20th International Conference on Ground Improvement Techniques, March 15 - 16, 2018, Paris, France, https://waset.org/conference/2018/03/paris/ICGIT

2nd Annual International Tunnelling and Underground Spac e Conference - Promoting the Use of Our Underground Space Exploring the Socioeconomic Benefits of Developing Tunnelling and Underground Space Infrastructure in Nigeria, 20-22 March 2018, Abuja FCT, Nigeria, http://tunnellingnigeria.org

1st International Conference on Advances in Rock Mechanics
29-31 March 2018, Hammamet, Tunisia
www.atmr.tn/index.php/en/tunirock2018

On behalf of the organizing committee, I am delighted to invite you to attend the International Conference on Advances in Rock Mechanics, an ISRM Specialized Conference (TuniRock 2018) to be held in Hammamet, Tunisia, on March 29-31, 2018. This Conference aims at bringing together researchers and engineers around the most recent advances in Rock mechanics and rock engineering applications. The exciting program that the Tunisian Society for Rock Mechanics prepared includes technical and scientific sessions, keynote lectures, one-day workshops and a social and cultural program.

Topics

- Rock Mass Characterization
- Laboratory and In situ Testing
- Hard soils-soft rocks
- THMC modeling in rocks
- Mine design
- Vibrations from blasting
- Mechanical breakage of Rocks
- Tunneling and ground support
- Petroleum Rock Mechanics
- Slope and Open pit Stability
- Risk in Rock Engineering Design
- Subsidence
- Geothermal energy
- Natural and ornamental stones

Workshops

- Fractured Rock Mass description
- Deterministic and Probabilistic Rock Slope Stability Analyses

Contact Person: Prof. Essaieb Hamdi

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BP 37 - Le Belvédère 1002, Tunis, Tunisia
Telephone: +216 20323289
Fax: +216 71872729
E-mail: essaieb@yahoo.fr

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SAHC 2018 11th International Conference on Structural Analysis of Historical Constructions "An interdisciplinary approach", 11-13 September 2018, Cusco, Perứ 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

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

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

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

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

2019 Rock Dynamics Summit in Okinawa
7-11 May 2019, Okinawa, Japan

Contact Person: Prof. Aydan Omer, aydan@tec.u-ryukyu.ac.jp

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

It is a great pleasure and an honour to extend to you a warm invitation to attend the 7th International Conference on Earthquake Geotechnical Engineering (VII ICEGE) in Roma, Italy, 17-20 June 2019.

After the increasingly successful conferences held in Tokyo 1995, Lisbon 1999, Berkeley 2004, Thessaloniki 2007, Santiago 2011 and Christchurch 2015, the Italian Geotechnical Society (AGI) on appointment by the ISSMGE Technical Committee 203 ('Earthquake Geotechnical Engineering and associated problems') is delighted to announce that Roma will host the 7th International Conference on Earthquake Geotechnical Engineering (VII ICEGE) from 17 to 20 June 2019.

As in the previous editions, the conference topics will address through general and parallel sessions the most recent developments in earthquake geotechnical engineering, stimulating fruitful technical and scientific interaction within the fields of seismology, geophysics, geology, structural as well as infrastructural engineering.

We believe that VII ICEGE will provide an excellent opportunity to present recent experience and developments to an audience of engineers, geologists and seismologists, consultants, public and private contractors, local national and international authorities, and to all those involved in research and practice related to earthquake geotechnical engineering.

Last but not least, the 'Eternal City' of Roma is one of the most attractive and emblematic locations in the world, thanks to its impressive cultural heritage, the pleasant weather and its extraordinary social life, not to mention the taste of the Italian food.

The Eternal City will offer you a wonderful journey through Science and History!

TOPICS

The session themes will include, however are not limited, to the following topics:

1. Seismic hazard, ground motion records and prediction
2. Surface fault rupture and near-fault effects
3. Field and laboratory testing on soils and rocks
4. Physical modelling, shaking table and centrifuge tests
5. Seismic site characterization
6. Constitutive and numerical models for dynamic analyses
7. Seismic response analysis, site amplification and microzonation
8. Liquefaction, lateral spreading and their impacts
9. Stability of natural slopes, cavities and mining digs
10. Embankments, levees and dams
11. Landfills and waste repositories
12. Ground improvement, reinforced soil structures and geosynthetics
13. Waterfront and offshore structures

14. Earth-retaining structures
15. Tunnels and underground structures
16. Lifeline earthquake engineering
17. Shallow and deep foundations
18. Soil-foundation-structure interaction
19. Case histories and instrumented test sites
20. Safeguard of monuments and cultural heritage
21. Lessons learned from recent and past earthquakes
22. Developments in performance-based design, codes and standards of practice
23. Metamaterials and other innovative technologies for seismic protection
24. Emergency, urban systems and resilient communities
25. Risk management and insurance issues
26. Multi-hazards, tsunamis and induced earthquakes
27. Education and preparedness

Secretariat:

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Viale dell'Università 11, 00185 Roma, Italy
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AGI website: www.associazionegeotecnica.it
Event website: www.7icege.com
E-mail: info@7icege.com

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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.

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

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

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

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

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

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

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

□ □

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

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

□ □

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

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

□ □

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

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

Huge landslide triggered rare Greenland mega-tsunami

Scientists hope studying last month's deadly event will improve modelling of rockslides that could become more frequent with climate change.

Chunks of glacier shattered when a powerful tsunami ripped through a fjord in western Greenland in June.

One of the tallest tsunamis in recorded history — a 100-metre-high wave that devastated a remote settlement in Greenland last month — was caused, unusually, by a massive landslide, researchers report.

Seismologists returning from studying the rare event hope that the data they have collected will improve models of landslide mechanics in glacial areas and provide a better understanding of the associated tsunami risks. They warn that such events could become more frequent as the climate warms.

The landslide occurred on the evening of 17 June, in the barren Karrat Fjord on the west coast of Greenland. It caused a sudden surge of seawater that wreaked havoc in the fishing village of Nuugaatsiaq, located on an island within the fjord about 20 kilometres away. The wave washed away eleven houses, and four people are presumed dead.

The slide was so large that it generated a seismic signal suggestive of a magnitude-4.1 earthquake, confounding initial efforts to identify its cause, says Trine Dahl-Jensen, a seismologist at the Geological Survey of Denmark and Greenland. But more careful examination indicated no significant tectonic activity just before the landslide.

A research team that visited the site earlier this month found that a large volume of rock had plunged — probably spontaneously — from one of the steep sides of the fjord into the water 1,000 metres below, and shattered chunks of a glacier. That disturbance pushed water levels up by more than 90 metres along the coastline on the same side as the slide. And although the tsunami dissipated quickly as it crossed the deep, six-kilometre-wide fjord, it still had enough energy to send water 50 metres up the hillside opposite. The team also measured an increase in water levels of about 10 metres on shorelines 30 kilometres away.

"Landslide-generated tsunamis are much more locally limited than tsunamis produced by sea quakes, but they can be massively tall and devastating in the vicinity," says Hermann Fritz, an environmental engineer at the Georgia Institute of Technology in Atlanta who led the research team.

On the rocks

Fritz and his team hope to produce a 3D reconstruction of the Greenland event.

Such information is sorely needed, says Costas Synolakis, a tsunami researcher at the University of Southern California in Los Angeles who was not involved in the Greenland survey. In cold, glacial regions, rocks and ice are held together on steep rock sides, and rising temperatures could make these slopes unstable and these events more common.

Synolakis says that his team has documented in detail only two landslides near glaciers. "We need at least ten such events to be able to have some rudimentary confidence in landslide computational models to study future impacts and establish early warning criteria."

Researchers have noted another potentially imminent landslide in the Karrat Fjord, says Fritz, where a slow trickle of rocks could turn into abrupt slide. Residents of three villages in the region have been permanently evacuated to the nearby town of Uummannaq.

Fritz adds that the Greenland event is reminiscent of a 1958 tsunami — the tallest ever recorded[1]— in Lituya Bay, Alaska. A magnitude-8.3 quake triggered a landslide into a narrow fjord and the bay's shallow water, causing the water to rise 500 metres above the normal tide level (a measure known as run-up). By comparison, the 2011 quake-triggered tsunami in Japan, which killed more than 16,000 people and caused the Fukushima nuclear disaster, reached only about 40 metres at its maximum height.

And in 2015, a landslide-generated tsunami in the Taan Fjord in Icy Bay, Alaska, caused a 300-metre run-up of water, says Synolakis.

The tsunami wreaked havoc on the small village of Nuugaatsiaq, located on an island within a fjord.

"Earlier, we didn't really believe such extremes were possible," he says. "But with global warming and sea level rise, such landslides are going to be far more common."

References

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Nature | doi:10.1038/nature.2017.22374

(Quirin Schiermeier / Nature, 31 July 2017, https://www.nature.com/news/huge-landslide-triggered-rare-greenland-mega-tsunami-1.22374#/b1)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

How strike-slip faults form, the origin of earthquakes

Dextral Basin-and-Range strike-slip fault near Las Vegas.

Structural geologist Michele Cooke calls it the "million-dollar question" that underlies all work in her laboratory at the University of Massachusetts Amherst: what goes on deep in the earth as strike-slip faults form in the crust? This is the fault type that occurs when two tectonic plates slide past one another, generating the waves of energy we sometimes feel as earthquakes.

Geologists have been uncertain about the factors that govern how new faults grow, says Cooke. In recent years she and colleagues have offered the first systematic explorations of such fault evolution. In their new paper, she and her team of students provide experimental results to illustrate the process, with videos, and report on how they reenact such events in wet clay in the lab. Details appear in the current online edition of Journal of Structural Geology.

Cooke says, "When I give talks to other geologists I put up a picture of a fault and ask, wouldn't you love to be able to see exactly how that formed? Well, in my lab that's what we do. We set up the conditions for faulting on a small scale and watch them unfold. People have done this before, but we've developed methods so we can see faults grow in very, very fine detail, at a finer resolution than anyone has documented before."

https://youtu.be/WCIToKGGZOM

An animation of the evolution of shear strain in one of the experiments by UMass Amherst structural geologist Michele Cooke, who models strike-slip faults that occur when two tectonic plates slide past one another, generating energy waves we feel as earthquakes. Red colors are shear strain that exceeds the experiment's threshold for localized faulting. Cooke and colleagues recently offered the first systematic explorations of such fault evolution.

The UMass Amherst researchers take a mechanical efficiency approach to understanding fault development. It states that faults in the crust reorganize in accord with "work optimization" principles, or what Cooke refers to as the "Lazy Earth" hypothesis. It focuses on fault systems' effectiveness at transforming input energy into movement along the faults. Like lightning striking the closest object, when forming a fault the earth takes the easiest path.

For this National Science Foundation-supported work, the researchers load a tray with kaolin, also known as china clay, prepared so its viscosity and length scale to that of the earth's crust. All the experiments involve two slabs of wet clay moving in opposite directions under one of three base boundary conditions, that is, different ways of "loading" the fault. One scenario begins with a pre-existing fault, another with localized displacement beneath the clay, and a third that is characterized by a displacement across a wider zone of shear beneath the clay.

Data from the two-hour experiments record strain localization and fault evolution that represents millions of years at the scale of tens of kilometers during strike-slip fault maturation. Cooke says, "We have captured very different conditions for fault formation in our experiments that represent a range of conditions that might drive faulting in the crust."

She adds, "We found that faults do evolve to increase kinematic efficiency under different conditions, and we learned some surprising things along the way. One of them is that faults shut off along the way. We suspected this, but our experiment is the first to document it in detail. Another especially surprising finding is that fault irregularities, which are inefficient, persist rather than the system forming a straight, efficient fault."

The authors, who include graduate students Alex Hatem and Kevin Toeneboehn, identify four stages in fault evoution: pre-faulting, localization, linkage and slip. The process starts simply, advances to a peak of complexity, after which complexity suddenly drops off and the fault simplifies again, lengthening into a "through-going" or continuous single, surface crack.

In videos by Hatem, shear strain is clearly seen to distort the crust along the area where two base plates meet. In the next stage numerous echelon faults develop. These arestep-like fractures parallel to each other that get pulled lengthwise as strain increases until they suddenly link. In the last stage, these join to form a final single fault. Cooke says, "We were very excited to see that portions of thefaults shut off as the system reorganized, and also that the irregularities persisted along the faults."

An interesting finding, but not a surprise is that for the most part all faults went through a similar process. Cooke says, "We tested the various extremes but came out of this with a common kind of evolution that's true for all. If there's not already a fault, then you see echelon faults, small faults parallel to each other but at an angle to the shear. Probably the most insightful bit is the details of fault evolution within those extremes. What you're left with at the end is a long fault with abandoned segments on either side, which is something we see in the field all the time. It's a nice confirmation that our lab experiments replicate what is going on within the Earth."

Another insight, the researchers say, results from measuring the kinematic or geometric efficiency, the percent of applied displacement expressed as slip on the faults. "An inefficient fault will have less slip and more deformation around the zones," Cooke explains. "We can see it happening in the experiments and it supports the idea that faults evolve to become efficient and the earth optimizes work. This is the Lazy Earth; the efficiency is increasing even though the fault is becoming more complex."

Finally, the geologist adds, "We saw that when the faults eventually link up, they don't necessarily make a perfectly straight fault. That tells me that irregularities can persist along mature faults because of the material. It's an insight into how you get persistent irregularities that we see in the real earth's crust. Structural geologists are surprised by irregularities, because if faults evolve to minimize work then all faults should be straight. But we have evidence now to show these irregularities persist. We have irregular faults that are active for millions of years."

Source: UMASS

Reference:

"Strain localization and evolving kinematic efficiency of initiating strike-slip faults within wet kaolin experiments" - Alexandra E. Hatem et al. - Journal of Structural Geology - 2017 - https://doi.org/10.1016/j.jsg.2017.06.011

Abstract

Using wet kaolin experiments, we document the evolution of strain localization during strike-slip fault maturation under variable boundary conditions (pre-existing fault, depth of and distribution of basal shear). While the nature of the basal shear influences strain localization observed at the clay surface, similarities between experiments reveal a general conceptual model of strain accommodation. First, shear strain is accommodated as distributed shear (Stage 0), then by development of echelon faults (Stage I), then by interaction, lengthening and propagation of those echelon faults (Stage II) and, finally, by slip along through-going fault (Stage III). Stage II serves as a transitory period when the system reorganizes after sufficient strain localization. Here, active fault system complexity is maximized as faults link producing apparent rotation of active fault surfaces without material rotation. As the shear zone narrows, off-fault deformation decreases while fault slip and kinematic efficiency increases. We quantify kinematic efficiency as the ratio of fault slip to applied displacement. All fault systems reach a steady-state efficiency in excess of 80%. Despite reducing off-fault deformation, the through-going fault maintains <1.5 cm structural irregularities (i.e., stepovers), which suggests that small (<3 km) stepovers may persist along mature, efficient faults in the crust.

(THE WATCHERS, July 08, 2017, https://watchers.news/2017/07/08/how-strike-slip-faults-form)

The 10 Largest Base-Isolated Buildings in the World

Base isolation is a method for moderating the effects of earthquakes on buildings. Isolator devices (either elastic or sliding) are installed between the foundation and the building superstructure. The accompanying slide show looks at the ten largest base-isolated buildings in the world, measured by total floor area.

"The use of base isolation as seismic protection for buildings, bridges and industrial facilities continues to grow, but has done so more robustly internationally than in the U.S.," says Ronald Hamburger, Senior Principal with Simpson Gumpertz & Heger, a leading seismic engineering firm.

Not surprisingly, Japan, the most seismically active country, employs it most extensively, with 4,100 base-isolated commercial and institutional buildings as of December 2015, according to the Japan Society of Seismic Isolation. "Japan looks at base isolation as a primary option," says Konrad Eriksen, President of Dynamic Isolation Systems Inc., a leading designer and manufacturer of isolators. "In the Japanese residential market, prospective condo owners will pay a premium for a base-isolated building compared to a conventional building," says Gordon Wray, associate principal at Degenkolb Engineers, another prominent seismic engineering firm.

Turkey, another very seismically active country, is also firmly committed to base-isolation methodology. Notably, it has embarked on a $13.6-billion program to build numerous large modern hospitals, most of which will be base-isolated. In addition, major bridges and viaducts have also been protected in this fashion.

One notable project under construction in Turkey is the Ikitelli Integrated Health Campus in Istanbul. The 2,330-bed main hospital building there is expected to contain 2,000 isolators. It is a public-private partnership being developed by Istanbul PPP Sağlık Yatırım A.Ş. When completed, it is expected to be the largest base-isolated building in the world.

Other countries pushing base isolation include China, New Zealand, Chile, Peru, Colombia and Ecuador. In contrast, "in the U.S., seismic isolation is used relatively infrequently," according to Hamburger. "In recent years, the inaccurate perception that other structural systems, including energy-dissipated moment frames, or buckling-restrained braced frames, can provide similar protection at lower first cost has slowed the growth of this technology in the U.S."

"In the U.S., seismic resilience is taken for granted because of the recent infrequency of earthquakes and several decades of good building codes," says Wray. "Modern buildings have performed well in recent earthquakes (few collapses), although we have not yet experienced a code-level earthquake in a densely populated area in 23 years. I believe that many building owners have an expectation of operational performance, when typical code buildings are designed only to protect life-safety."

Seismic-isolation technologies fall into two categories: elastomeric and sliding systems. Elastomeric isolation systems consist of natural rubber; natural rubber with lead cores to dissipate energy; and high-damping rubber, consisting of blends of natural and synthetic compounds. Sliding systems generally include flat sliders, typically used in combination with elastomeric bearings and friction pendulum devices. Within the friction pendulum category there are a series of different designs, including the original system that employed a single curved dish and sliding element; a double pendulum, in which two curved dish surfaces are employed; and a triple pendulum employing three such surfaces. "The triple pendulum system reduces the size of the isolator while increasing its effectiveness," says Farzad Naeim, a prominent structural engineer and former president of the Earthquake Engineering Research Institute.

Elastomeric bearings were first used on bridges in the 1950s and were found to be an improvement over mechanical bearings, which suffered from corrosion, according to Eriksen. Friction pendulum bearings were developed in the late 1980s. "Friction pendulum bearings dominate applications in the U.S., in some other important markets like Turkey, and most applications in certain types of structures worldwide (offshore oil platforms, LNG tanks, large bridges, hospitals)," says Michael Constantinou, professor of civil, structural and environmental engineering at the State University of New York at Buffalo.

"Elastomeric systems perform best in large buildings, which have large axial loads," explains Wray. "Sliding systems perform well for both large and small axial loads (large and small buildings). The behavior of sliding systems underhigh-frequency vertical acceleration continues to be stud- ied."

Deformation in a building during a large earthquake is inevitable. "Using conventional lateral force resisting systems, the deformation is distributed up the height of the building among many beams, columns, connections, braces, or shear walls," comments Wray. In comparison, "using base isolation, (nearly) all of the building deformation is concentrated at the isolation plane, limiting damage up the height of the building. The magnitude of the displacement can be predicted with more certainty than the individual deformations among hundreds or thousands of individual components of a lateral system."

"Of all the seismic protection technologies presently available, seismic isolation offers the most effective protection against damage or loss of function following strong shaking," says Hamburger. "Other structural technologies allow transmission of the motion into the structure, where its energy is dissipated either through damage to the structural elements, or through more benign energy dissipation mechanisms. Regardless, structures employing these other technologies experience greater motion and as a result more damage than do isolated structures."

The evolution and spread of base isolation is influenced by many players. "Governments have played a role in funding research to develop these technologies, including Natonal Science Foundation-funded centers such as the Pacific Earthquake Engineering Research center at UC Berkeley and the Multidisciplinary Center for Earthquake Engineering Research at the State University of New York at Buffalo," says Constantinou. "Insurance agencies (and owners) have not yet taken into consideration the reduced risk of damage for a seismically isolated structure. This may change following the work of the U.S. Resiliency Council on rating building performance."

The USRC membership includes all the major professional organizations in earthquake and structural engineering, structural engineering firms, architectural firms, contractors, and hardware and software suppliers. The USRC rating system rates buildings from one to five stars for each of three criteria: safety, damage and recovery. "While many lateral systems can provide high ratings for safety, base-isolated buildings provide the greatest opportunity to achieve high ratings for damage and recovery," says Wray.

"The USRC will certify raters and review ratings after they are submitted, similar to the USGBC's LEED ratings for sustainability," says Ronald Mayes, USRC executive director and co-founder. "The rating is a different way of specifying what an owner's performance expectations are for a building. I think it will become a powerful tool." The rating system launched in December, 2015. One building has been rated so far, with 18 more in process, according to Mayes.

"The structural engineering community in the past has done a poor job of communicating what a code-designed building delivers, as attested by the performance of modern buildings in the 2011 Christchurch New Zealand earthquake, where more than 50% of the modern buildings in the central business district delivered life-safety performance but had to be demolished after the earthquake," adds Mayes.

"The Insurance industry has done little to encourage the use of seismic isolation, and it could be said that offering an earthquake mitigation alternative to developing earthquake-resistant structures, actually provides a disincentive," says Hamburger. "The primary insurance benefit the owner of a seismically isolated structure obtains is through an ability to purchase greatly reduced levels of protection. Some owners have chosen to use base isolation as their earthquake insurance of choice, as any damage that may occur is well below current deductibles. In addition, base isolation provides business continuity, something that is very difficult to cover with insurance."

1. Apple Park, Cupertino, California, 445,005 square meters. Apple's new corporate headquarters is a four-story, ring-shaped building, with a circumference of 1,512 sq ft. It houses 12,000 employees and opened in April 2017. It was designed by Foster and Partners. In addition to the four floors above ground, it also includes three stories below ground. The building sits on top of 700 base isolators. Each isolator is 7 ft in diameter and weighs about 15,000 lbs. The

isolators were customized for low friction, according to the lead structural engineer, John Worley, of Arup. Construction of the entire Apple Campus 2, including the headquarters building as well as a 1,000-seat auditorium (the Steve Jobs Theater), a wellness-fitness center, two R&D buildings, a visitor center and parking structures, totaled $5 billion. The building's inner part is a 30-acre park, featuring fruit trees, winding paths and a pond.

2. Adana Integrated Health Campus, Adana, Turkey, 430,000 square meters. The campus was developed as a public-private partnership between ADN PPP Sağlık Yatırım A.Ş., a joint venture of four firms, and the Turkish Ministry of Health. The campus will have a total capacity of 1,550 beds housed in three hospitals: the 1,300-bed main hospital, a 150-bed physical-therapy and rehabilitation hospital and a 100-bed high-security criminal psychiatric hospital. The campus is supported by 1,512 base isolators. The complex was designed by HWP, and built by Rönesans Sağlık Yatırım. The structural engineer was Ulker Engineering Ltd. It was completed in May, 2017.

3. Tokyo Skytree East Tower, Tokyo, 229,237 square meters. This mixed-use complex includes an office tower, mall and entertainment complex. An eight-story podium contains a shopping center, planetarium and theater serving millions

of tourists visiting the observatories on the adjacent Tokyo Skytree tower. The office tower rises to 31 stories. The complex was designed by Nikken Sekkei and built by Obayashi Corp. It was completed in 2012.

4. Isparta City Hospital, Isparta, Turkey, 221,000 square meters. Akfen Holding, a Turkish conglomerate, built the hospital as part of a 25-year public private partnership with the Turkish Ministry of Health. Dost Insaat ve Proje Yonetimi A.S. served as the design-builder of the 755-bed facility, with architectural firm Yazgan Mimarlık & Hayalgucu Mimarlık J.V. Handling the design work. The base isolation system features 903 surface-friction-slider units supplied by Maurer AG. The project's structural engineer was Probi Insaat Proje Bilgi Islem Merkezi A.S. It was completed in December 2016.

5. Logistics Park Hino, Tokyo, 212,853 square meters. A five-level warehouse with spiral ramps at both ends, it was designed by Obayashigumi Design Office and built by the Obayashi Corp. It was completed in 2015. It is owned by Mitsui Fudosan Co., Ltd.

6. Logiport Sagamihara, Sagamihara, Japan. 210,000 square meters. A five-level warehouse with spiral ramps at both ends, it was designed by Obayashigumi Design Office and built by the Obayashi Corp. It was completed in 2013. Sagamihara is a western suburb of Tokyo.

7. Shinagawa Season Terrace, Tokyo, 205,786 square meters. An office building, it was designed by the NTT Facilities Design Office and built by Taisei Corp. It was completed in 2015.

8. Sabiha Gökçen Airport International Terminal, Istanbul, 200,000 square meters. ISG, a partnership of Limak Holding (LIMAK), GMR Infrastructure Limited (GMR) and Malaysia Airports Holdings Berhad (MAHB) is the operator of the airport under a 20-year build-operate-transfer agreement signed in 2008. Tasked with completing the terminal in 18 months, Limak and GMR formed a joint venture and signed an EPC contract with ISG. The building's footprint is 160 m x 272 m and includes four stories above a basement level. It can serve 16 middle-sized fuselage aircraft or eight wide-body planes simultaneously. It features seven arched bays with vaulting roofs of alternating 32-m and 48-m spans, employing space frame trusses. The superstructure is a steel moment frame, resting on 292 triple-friction-pendulum isolation bearings supplied by Earthquake Protection Systems, Inc. The structural engineer who led the seismic design for the terminal was Atila Zekioglu, of Arup. The terminal opened in 2009.

9. Erzurum Regional Research and Training Hospital, Erzurum, Turkey, 180,000 square meters. It was built by Kur Construction Co. Ltd. This 400-bed hospital is supported by 386 lead-rubber bearing isolators, which were supplied by Dynamic Isolation Systems Inc.

10. Tan Tzu Medical Center, Tai Chung, Taiwan, 157,930 square meters. Designed by C.C. Hsu & Associates, the complex includes a four- to six-story western section, a 17-story tower, and two underground levels containing parking, storage space and a cafeteria. The 1,300-bed medical center rests on 325 lead-rubber-bearing base isolators located below the second underground level. The building also is outfitted with 88 fluid viscous dampers. The lateral-force-resisting system of the superstructure consists of steel-reinforced-concrete moment frames. The total superstructure mass resting on the base-isolation system weighs 285,600 tons. The base-isolation system was designed by KPFF consulting engineers, led by Andrew W. Taylor. Construction was completed in 2006, at which time the structure was the largest base-isolated building in the world. The project was challenging, as the building is located only 400 m from the Chelungpu fault, which ruptured in the 1999 Chi-Chi earthquake.

(Scott Lewis / ENR, July 17, 2017, https://www.enr.com/articles/42366-the-10-largest-base-isolated-buildings-in-the-world)

Sea Cave Preserves 5,000-Year Snapshot of Tsunamis

Record tells us we don't know much about predicting earthquakes that cause tsunamis

An international team of scientists digging in a sea cave in Indonesia has discovered the world's most pristine record of tsunamis, a 5 000-year-old sedimentary snapshot that reveals for the first time how little is known about when earthquakes trigger massive waves.

"The devastating 2004 Indian Ocean tsunami caught millions of coastal residents and the scientific community off-guard," says co-author Benjamin Horton, a professor in the Department of Marine and Coastal Sciences at Rutgers University-New Brunswick. "Our geological record from a cave illustrates that we still cannot predict when the next earthquake will happen."

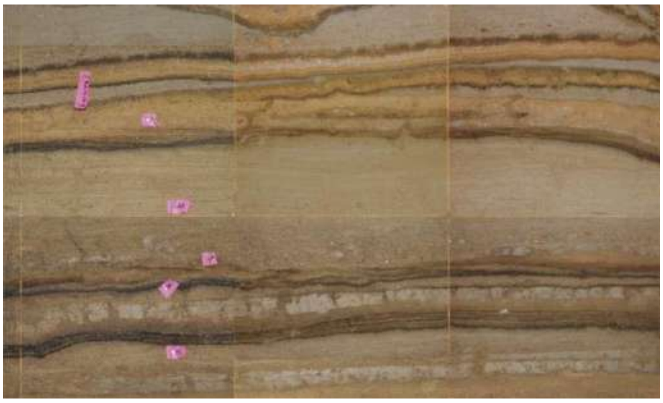
"Tsunamis are not evenly spaced through time," says Charles Rubin, the study's lead author and a professor at the Earth Observatory of Singapore, part of Nanyang Technological University. "Our findings present a worrying picture of highly erratic tsunami recurrence. There can be long periods between tsunamis, but you can also get major tsunamis that are separated by just a few decades."

The discovery, reported in the current issue of *Nature Communications*, logs a number of firsts: the first record of ancient tsunami activity found in a sea cave; the first record for such a long time period in the Indian Ocean; and the most pristine record of tsunamis anywhere in the world.

The bearded man is Nanyang Technological University archaeologist Patrick Daly, whose excavations in this sea cave led Kerry Sieh (pointing) and Charles Rubin of the Earth Observatory of Singapore and Rutgers' Benjamin Horton to look for tsunami records there. EOS graduate student Jedrzej Majewski, in the yellow shirt, stands behind Daly. Credit: Earth Observatory of Singapore

The discovery was made in a sea cave on the west coast of Sumatra in Indonesia, just south of the city of Banda Aceh, which was devastated by the tsunami of December 2004. The stratigraphic record reveals successive layers of sand, bat droppings and other debris laid down by tsunamis between 7 900 and 2 900 years ago. The stratigraphy since 2 900 years ago was washed away by the 2004 tsunami.

The L-shaped cave had a rim of rocks at the entrance that trapped successive layers of sand inside. The researchers dug six trenches and analyzed the alternating layers of sand and debris using radio carbon dating. The researchers define "pristine" as stratigraphic layers that are distinct and easy to read. "You have a layer of sand and a layer of organic material that includes bat droppings, so simply it is a layer of sand and a layer of bat crap, and so on, going back for 5 000 years," Horton says.



The stratigraphy of the sea cave in Sumatra excavated by scientists from the Earth Observatory of Singapore, Rutgers and other institutions. The lighter bands are sand deposited by tsunamis over a period of 5 000 years; the darker bands are organic material. Credit: Earth Observatory of Singapore

The record indicates that 11 tsunamis were generated during that period by earthquakes along the Sunda Megathrust, the 5 310-km-long (3 300-miles) fault running from Myanmar to Sumatra in the Indian Ocean. The researchers found there were two tsunami-free millennia during the 5 000 years, and one century in which four tsunamis struck the coast. In general, the scientists report, smaller tsunamis occur relatively close together, followed by long dormant periods, followed by great quakes and tsunamis, such as the one that struck in 2004.

Rubin, Horton and their colleagues were studying the seismic history of the Sunda Megathrust, which was responsible for the 2004 earthquake that triggered the disastrous tsunami. They were looking for places to take core samples that would give them a good stratigraphy.

This involves looking for what Horton calls "depositional places" - coastal plains, coastal lake bottoms, any place to plunge a hollow metal cylinder six or seven meters down and produce a readable sample. But for various reasons, there was no site along the southwest coast of Sumatra that would do the job. But Patrick Daly, an archaeologist at EOS who had been working on a dig in the coastal cave, told Rubin and Horton about it and suggested it might be the place they were looking for.

Looking for tsunami records in a sea cave was not something that would have occurred to Horton, and he says Daly's professional generosity - archaeologists are careful about who gets near their digs - and his own and Rubin's openness to insights from other disciplines made the research possible. Horton says this paper may be the most important in his career for another reason.

Using fluorescent lights, Kerry Sieh and Charles Rubin of the Earth Observatory of Singapore look for charcoal and shells for radiocarbon dating. Credit: Earth Observatory of Singapore

"A lot of (the research) I've done is incremental," he says. "I have a hypothesis, and I do deductive science to test the hypothesis. But this is really original, and original stuff doesn't happen all that often."

(Ken Branson / RUTGERS TODAY, 19 July 2017, http://news.rutgers.edu/research-news/sea-cave-preserves-5000-year-snapshot-tsunamis/20170623#.WXxUMYiGPIV)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

The UK's Geologic Wonders

This delightful rock arch and piles upon piles of rock layers can be seen at Lulworth Cove in Dorset, in southern England.

Staffa, an island in the Scotland Hebrides, is made of columnar basalt and "slaggy" basalt that erupted as lava flows during the Paleogene period. Geologists have found ash layers and thin soil layers that suggest the island had both explosive volcanic activity as well as quiet intervening

Lulworth Cove in Dorset, in southern England

Chalk cliffs at Seaford in East Sussex

Portknockie, North East Scotland

Callanish Stones are located on the island of Lewis, part of the Hebrides archipelago sitting off the northwest coast of Scotland

Marble Arch Caves are 7 miles (11.5 kilometers) long, making them the longest known cave system in Northern Ireland

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

The Crop Circle Mystery: A Closer Look

This massive 780-foot (238 meters) crop circle appeared in 2001 in the remote area of Milk Hill in Wiltshire, England. The elaborate design is composed of 409 circles that form a pattern called a double, or six-sided, triskelion, which is a motif consisting of three interlocking spirals.

Crop circles — strange patterns that appear mysteriously overnight in farmers' fields—provoke puzzlement, delight and intrigue among the press and public alike. The circles are mostly found in the United Kingdom, but have spread to dozens of countries around the world in past decades. The mystery has inspired countless books, blogs, fan groups, researchers (dubbed "cereologists") and even Hollywood films.

Despite having been studied for decades, the question remains: Who — or what — is making them?

Early crop circles

Many people believe that crop circles have been reported for centuries, a claim repeated in many books and websites devoted to the mystery. Their primary piece of evidence is a woodcut from 1678 that appears to show a field of oat stalks laid out in a circle. Some take this to be a first-hand eyewitness account of a crop circle, but a little historical investigation shows otherwise.

The woodcut actually illustrates what in folklore is called a "mowing devil" legend, in which an English farmer told a worker with whom he was feuding that he "would rather pay the Devil himself" to cut his oat field than pay the fee demanded. The source of the harvesting is not unknown or mysterious; it is indeed Satan himself, who — complete with signature horns and a tail — can be seen in the woodcut holding a scythe.

Some claim that the first crop circles (though they were not called that at the time) appeared near the small town of Tully, Australia. In 1966, a farmer said he saw a flying saucer rise up from a swampy area and fly away; when he went to investigate he saw a roughly circular area of debris and apparently flattened reeds and grass, which he assumed had been made by the alien spacecraft (but which police investigators said was likely caused by a natural phenomena such as a dust devil or waterspout). Referred in the press as "flying saucer nests," this story is more a UFO report than a crop circle report.

A woodcut pamphlet that some claim represents an early crop circle.

As in the 1678 mowing devil legend, the case for it being linked to crop circles is especially weak when we consider that the impression or formation was not made in a crop of any kind but instead in ordinary grass. A round impression in a lawn or grassy area is not necessarily mysterious (as anyone with a kiddie pool in the back yard knows). Indeed, mysterious circles have appeared in grass throughout the world that are sometimes attributed to fairies but instead caused by disease.

Modern crop circles

In fact, the first real crop circles didn't appear until the 1970s, when simple circles began appearing in the English countryside. The number and complexity of the circles increased dramatically, reaching a peak in the 1980s and 1990s when increasingly elaborate circles were produced, including those illustrating complex mathematical equations.

In July 1996, one of the world's most complex and spectacular crop circles appeared in England, across a highway from the mysterious and world-famous Stonehenge monument in the Wiltshire countryside. It was astonishing fractal pattern called a Julia Set, and while some simple or rough circles might be explained away as the result of a strange weather phenomenon, this one unmistakably demonstrated intelligence. The only question was whether that intelligence was terrestrial or extra-terrestrial.

Making the design all the more mysterious, it was claimed that the circle appeared in less than an hour and during the daytime — which, if true, would be virtually impossible for hoaxers to accomplish. The circle became one of the most famous and important crop circles in history.

It was later revealed that the circle had in fact been made in about three hours (by three hoaxers) very early that morning. It simply hadn't been noticed until the following afternoon when spotted from an airplane overhead.

People inspect crop circles within a golden wheat field in Switzerland. The photo was taken on July 29, 2007.

Theories & explanations

Unlike other mysterious phenomenon such as psychic powers, ghosts, or Bigfoot, there is no doubt that crop circles are "real." The evidence that they exist is clear and overwhelming. The real question is instead what creates them — and there are ways to investigate that question.

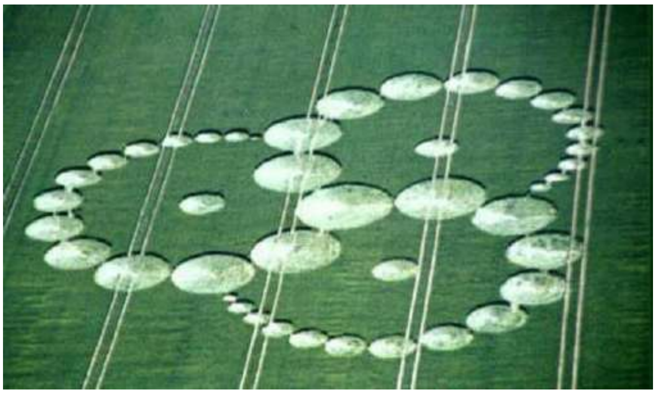
We can look at both internal and external evidence to evaluate crop circles. Internal information includes the content and meaning of the designs (is there anything that indicates that any information contained in the "messages" is of extraterrestrial origin?), and external information, including the physical construction of the crop designs themselves (is there anything that indicates that the designs were created by anything other than humans?)

Crop circle enthusiasts have come up with many theories about what create the patterns, ranging from the plausible to the absurd. One explanation in vogue in the early 1980s was that the mysterious circle patterns were accidentally produced by the especially vigorous sexual activity of horny hedgehogs. Some people have suggested that the circles are somehow created by localized and precise wind patterns, or by scientifically undetectable Earth energy fields and meridians called ley lines.

Others, such as molecular biologist Horace Drew, suggest that the answer lies instead in time travel or alien life. He theorizes that the patterns could be made by human time travelers from the distant future to help them navigate our planet. Drew, working on the assumption that the designs are intended as messages, believes he has decoded crop circle symbols and that they contain messages such as "Believe," "There is good out there," "Beware the bearers of false gifts and their broken promises," and "We oppose deception" (all, presumably, in English).

However, these odd, pseudo-biblical messages undermine the credibility of the crop circles, or at least the meaning read into them. Of all the information that an extraterrestrial intelligence might choose to convey to humanity — ranging from how to contact them to engineering secrets of faster-than-light travel — these aliens chose to impart intentionally cryptic messages about false gifts, broken promises, and hope for mankind (along with what seems to be a reference to a popular "The X-Files" slogan).

Many who favor an extraterrestrial explanation claim that aliens physically make the patterns themselves from spaceships; others suggest that they do it using invisible energy beams from space, saving them the trip down here. Still others believe that it is human, not extraterrestrial, thought and intelligence that is behind the patterns — not in the form of hoaxers but some sort of global psychic power that manifests itself in wheat and other crops.



Another triskelion crop circle. The symbol can be used to represent cycles, progress or competition.

While there are countless theories, the only known, proven cause of crop circles is humans. Their origin remained a mystery until September 1991, when two men confessed that they had created the patterns for decades as a prank to make people think UFOs had landed (they had been inspired by the 1966 Tully UFO report). They never claimed to have made all the circles — many were copycat pranks done by others — but their hoax launched the crop circle phenomena.

Most crop circle researchers admit that the vast majority of crop circles are created by hoaxers. But, they claim, there's a remaining tiny percentage that they can't explain. The real problem is that (despite unproven claims by a few researchers that stalks found inside "real" crop circles show unusual characteristics), there is no reliable scientific way to distinguish "real" crop circles from man-made ones.

Crop circle features

While there are always a few exceptions, virtually all crop circles share a set of common characteristics.

Circles. Crop circles, as the name implies, almost always involve circles — rarely triangles, rectangles, or squares, though some designs contain straight or curved lines. Perhaps not coincidentally, a circle is the easiest pattern for hoaxers to create.

This design of three flying birds was created on Aug. 3, 2003, in the county of Wiltshire in southern England. The birds, which resemble swallows, have ever-diminishing circles trailing behind their wing tips.

Nocturnal creation. Crop circles are formed overnight, often sighted by farmers or passersby the next morning. Though there seems no logical reason for extraterrestrials or earth energies to only create patterns at night, it is obviously a great advantage for hoaxers to create the designs under the cover of darkness; full moon nights are especially popular.

Camera shyness. Crop circles have never been recorded being made (except, of course, for those created by hoaxers). This is a very suspicious trait; after all, if mysterious earthly forces or aliens are at work, there's no reason to think that they wouldn't happen when cameras are recording.

Access to roads. Crop circles usually appear in fields that provide reasonably easy public access, close to roads and highways. They rarely appear in remote, inaccessible areas. Because of this, the patterns are usually noticed within a day or two of their creation by passing motorists.

There are many theories about what creates crop circles, including aliens, mysterious vortices, time travelers and wind patterns, but they all lack one important element: good evidence. The only known cause of crop circles is humans. Perhaps one day a mysterious, unknown source will be discovered for crop circles, but until the perhaps they are best thought of as collective public art.

Additional resources

- Ken Amis (Lock Haven University): The Truth About Crop Circles
- Smithsonian magazine: The Art of the Crop Circle
- Weather Channel: 30 Incredible Photos of Crop Circles

(Benjamin Radford, Live Science Contributor | June 9, 2017, https://www.livescience.com/26540-crop-circles.html?utm_source=notification)

Εύρηκα στο πιατάκι

Πώς μια γάτα ανακάλυψε νέο είδος πλαστικού

Μια απρόσεκτη γάτα έφερε επανάσταση στη βιομηχανία πλαστικών

Ο βαυαρός χημικός Άντολφ Σπίτελερ ήταν τυχερός που κρατούσε μια γάτα στο εργαστήριό του στα τέλη του 19ου αιώνα: το κατοικίδιο ανακάλυψε πώς μπορεί κανείς να μετατρέψει το απλό γάλα σε επαναστατικό νέο πλαστικό.

Ήταν το πλαστικό καζεΐνης, γνωστό και ως «γαλάλιθος», το δεύτερο πλαστικό που εφευρέθηκε μετά τη νιτροκυτταρίνη, η οποία παράγεται από φυτικό υλικό.

Ο γαλάλιθος παρέμεινε δημοφιλής για δεκαετίες, και ήταν το υλικό από το οποίο παράγονταν εξαιρετικά κουμπιά για ρούχα, ή ακόμα και κοσμήματα.

Η καζεΐνη είναι η κύρια πρωτεΐνη του γάλακτος (ή για την ακρίβεια μια οικογένεια συγγενικών πρωτεϊνών), η οποία ευθύνεται για το άσπρο χρώμα του και αποτελεί επίσης βασικό συστατικό του τυριού -πήρε μάλιστα το όνομά της από τη λατινική λέξη για το τυρί, caseus.

Ήταν ένα βράδυ του 1897 όταν ο Σπίτελερ (Adolf Spitteler, 1846 - 1940) άφησε στον πάγκο του εργαστηρίου του μια φιάλη φορμαλδεΰδης, εξιστορεί το περιοδικό Scientific American.

Στη διάρκεια της νύχτας, η απρόσεκτη γάτα έριξε το μπουκάλι και η φορμαλδεΰδη κύλησε στον πάγκο και έπεσε τελικά στο μπολ με το γάλα του ζώου. Όταν ο Σπίτελερ επέστρεψε το επόμενο πρωί, είδε ότι το γάλα είχε στερεοποιηθεί σε ένα σκληρό υλικό που θύμιζε κέρατο. Ουσιαστικά, η φορμαλδεΰδη είχε προκαλέσει τον πολυμερισμό των μορίων καζεΐνης σε μακριές αλυσίδες, παρόμοιες με αυτές από τις οποίες αποτελούνται όλα τα πλαστικά.

Σε συνεργασία με έναν γερμανό τυπογράφο, τον Βίλχελμ Κρίσε, ο Σπίτελερ τελειοποίησε τη μέθοδο παραγωγής πλαστικού από καζεΐνη και ίδρυσε την Vereinigte Gummiware Fabriken, την πρώτη εταιρεία που παρήγαγε το νέο υλικό σε βιομηχανική κλίμακα. Το ερευνητικό δίδυμο κατέθεσε αίτηση για δίπλωμα ευρεσιτεχνίας το 1899. Σύντομα, εταιρείες στην Ευρώπη άρχισαν να πειραματίζονται με τον γαλάλιθο.

Σε αντίθεση με άλλα πλαστικά, τα οποία μπορούν να χυθούν σε καλούπια, το πλαστικό καζεΐνης παραγόταν σε φύλλα ή ράβδους από τις οποίες σκαλίζονταν τα επιθυμητά σχήματα. Μια από τις κυριότερες χρήσεις του ήταν στην παραγωγή κουμπιών για ρούχα, τα οποία ήταν πιο ανθεκτικά στο σιδέρωμα σε σχέση με άλλα υλικά.

Ο γαλάλιθος γνώρισε τη δόξα τις δεκαετίες του 1920 και '30, μέχρι που ο Δεύτερος Παγκόσμιος Πόλεμος οδήγησε σε περιορισμούς της χρήσης γάλακτος σε μη βρώσιμα προϊόντα.

Σήμερα, η καζεΐνη χρησιμοποιείται κυρίως στη βιομηχανία τροφίμων και στη φαρμακοβιομηχανία.

(Newsroom ΔΟΛ, 6 Ιουλ. 2017, http://news.in.gr/science-technology/article/?aid=1500153306#ref=newsletter)

A Cat Turned Milk into Popular Plastic

Casein, used in artistic buttons and now coffee creamer, got started when a cat got rowdy in a lab

There are a lot of things you can do with milk: pour it in tea or on cereal, whip it into a milkshake, ferment it into yoghurt or cheese, and much more. But did you know you can also turn milk into plastic? That's thanks to casein – the main protein found in milk (or, more accurately, a family of related proteins) – responsible for giving the white stuff its colour and named after the Latin word for cheese, caseus …………………

(Kat Arney / Chemistry World - Scientific American, June 28, 2017, https://www.scientificamerican.com/article/a-cat-turned-milk-into-popular-plastic/#)

Γίνεται να τηλεμεταφέρουμε ένα «αντικείμενο» στο διάστημα; Γίνεται!

Ακούγεται ως αποκύημα επιστημονικής φαντασίας. Και πράγματι, αν νομίζετε ότι εννοούμε ένα παπούτσι ή έναν άνθρωπο, τότε είναι. Ακόμα, τουλάχιστον. Και πάλι, όμως, αυτό που κατάφεραν επιστήμονες στην Κίνα, είναι απίστευτο και ανοίγει διάπλατα νέους δρόμους στην επικοινωνία και την μεταφορά δεδομένων.

Ας προσπαθήσουμε, όμως, να εξηγήσουμε τί ακριβώς κατάφεραν οι Κινέζοι. Και θα χρησιμοποιήσουμε τα λόγια του Ίαν Γουάλμσλεϊ, καθηγητή πειραματικής φυσικής στο πανεπιστήμιο της Οξφόρδης, για να γίνουμε όσο το δυνατόν πιο κατανοητοί.

«Αυτό που έκαναν στην ουσία, είναι να επικοινωνήσουν πληροφορίες με έναν τρόπο, που χρησιμοποιεί την κβαντική μηχανική. Σε ένα φωτόνιο στη Γη, είχαν πληροφορίες που κατάφεραν να τις μεταφέρουν σε ένα δεύτερο φωτόνιο σε δορυφόρο στο διάστημα».

Ουσιαστικά το δεύτερο φωτόνιο «κλωνοποιήθηκε» και από εκεί που δεν είχε καθόλου δεδομένα, απέκτησε όλα τα δεδομένα του πρώτου φωτονίου στη Γη. Μπορεί να μην ακούγεται πολύπλοκο (θυμίζει λίγο copy-paste), όμως η αλήθεια είναι ότι η ακριβής διαδικασία που χρησιμοποιήθηκε είναι αρκετά περίπλοκη. Ωστόσο, τα αποτελέσματά της μπορεί σε λίγα χρόνια να αλλάξουν τις ζωές μας.

«Αυτή είναι η πρώτη φορά που μεταφέρθηκαν δεδομένα με κβαντική τηλεμεταφορά σε τόσο μεγάλη απόσταση. Αυτό είναι το πρώτο βήμα προς το παγκόσμιο κβαντικό ίντερνετ», συμπλήρωσε ο Γουάλμσλεϊ.

Αυτό ακούγεται απίστευτο! Και μόνο ο συνδυασμός των λέξεων κβαντικό και ίντερνετ είναι αρκετός για να μας φέρει όμορφες σκέψεις. Επίσης, αυτή η επιτυχία τοποθετεί την Κίνα στο κέντρο των επιστημονικών εξελίξεων, για πρώτη ίσως φορά στην ιστορία της, καθώς τηλεμεταφορά φωτονίων είχε επιτευχθεί ξανά στο παρελθόν, σε αποστάσεις όμως εντός ενός εργαστηρίου. Όχι από τη Γη στο διάστημα!

(Βασίλης Τσίγκας / Reader, Τρί, 11.07.2017, https://www.reader.gr/news/tehnologia/ginetai-na-tilemetaferoyme-ena-antikeimeno-sto-diastima-ginetai)

Top 5 Engineering Destinations to See Before You Die

If you're an engineer and you like to travel, there are some places that you just have to have on your bucket list. While there are countless engineering marvels across the globe and even more countless documentaries on all of them, some places you just have to see in person. Whether they're world wonders or feats of modern engineering, all of these places possess certain awe-inspiring qualities sure to make your trip worth it. Here are the 5 best engineering destinations that you need to see before you die!

The Palm Islands, UAE

The Palm Islands are a set of 3 artificial islands off the coast of Dubai in the UAE. Construction on these islands started in 2001 but as of now, the only completed and fully functional island is Palm Jumeirah. This island looks like a palm tree and is filled with a series of hotels and rooms.

The construction of the islands was the first endeavor to create manmade islands in artistic shapes that would hold residential developments. The effect of the islands goes far beyond their fame and unfortunately has had some impacts on the surrounding wildlife. The area surrounding the islands has seen increased coastal erosion and odd wave patterns. Sediment from the construction ultimately suffocated and injured many of the marine life around the area and reduced the sunlight allowed through the water. The palm islands are an incredible feat of engineering, but you might keep them off your list of places to visit if you don't appreciate the negative environmental effects. It isn't on this list, but while you're in Dubai, visiting the Burj Kalifa is a must see attraction for engineers.

Taj Mahal, India

The Taj Mahal is one of the seven modern wonders of the world. It is an ivory-white marble mausoleum that sits in the Indian City of Agra. The entire complex of the mausoleum is **42 acres** with the white palace sitting right in the center. The tomb has a mosque and a guest house included in the construction which is all surrounded by formal gardens.

Construction was completed in 1643 but work continued long after. The Taj Mahal cost **52.8 billion rupees**, USD $827 million in modern money. Over **20,000 people** worked on the construction project lead by architects and artists. One of the key elements of the project was to allow free expression from various world-renown artisans of the time, which is exactly what the emperor who commissioned the project did. Construction of the giant stone structure required earthen ramps over a mile long leading up to the tomb in order to lift the large stones into place. In 1983, the site was designated as a UNESCO World Heritage Site for being one of the most prime examples of Muslim art in the world. Over **7 million people** visit the temple each year and thanks to modern restoration efforts, the Taj Mahal should live on for many more years.

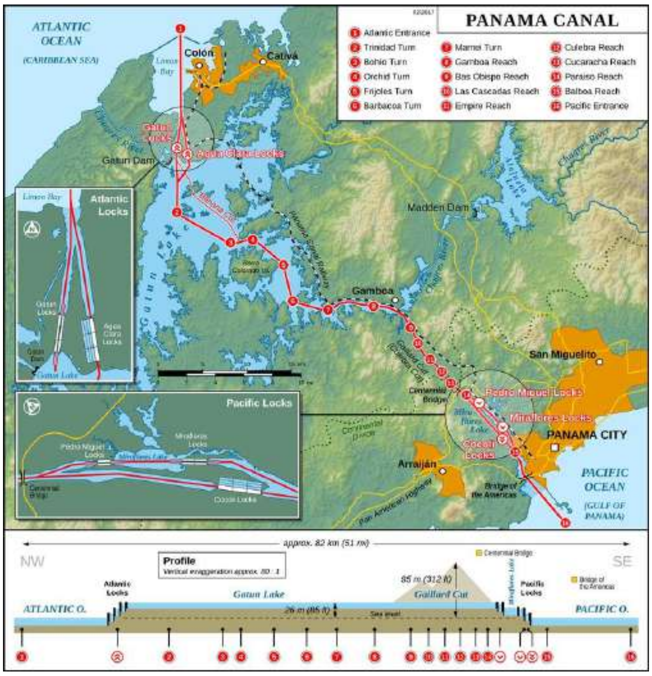
The Great Wall of China, China

The Great Wall of China is one of the most prolific engineering feats of all time. This stone brick and earthen wall was built along the historical border of China to protect the empire from invasions and raids from nomadic groups. While the wall may seem like an engineering project, it was actually built over many millennia from 600 BC all the way up to 1644 AD. Several walls were built in the 7th century BC later connected to what is now the Great Wall. Most of the modern wall was built and embellished during the Ming Dynasty.

Apart from the common known use for the wall to keep out attackers, the Great Wall has also been used for border controls allowing the regulated flow of imports and exports. Defenses on the wall were enhanced in later parts of its construction with watchtowers, barracks, garrison stations, and even signaling capabilities through smoke and fire.

The entire wall stretches from Dandong, China to the southern edge of Inner Mongolia. The Ming wall's total **5,500 miles**, made up of 3,889 miles of wall, 223 miles of trenches and 1,387 miles of natural barriers. The entire wall stretches a total of 13,171 miles from start to finish. Don't worry, you don't have to see all of the wall to enjoy the engineering behind it.

The Panama Canal, Panama



The Panama Canal is the primary way for ships to get from the Atlantic Ocean to the Pacific and vice versa. This waterway consists of a **48-mile** artificial canal that cuts through many natural lakes in the South American country. Various locks allow ships to progress the major elevation change with ease. The original locks were just 110 feet wide but a third wider land of locks was constructed within the last decade. These wider locks allowed for larger cargo ships to pass through the canal thus increasing the canal's usefulness.

Construction of the canal began as far back as 1881 by France but was stopped due to high worker mortality rate. The US took over the project in the early 1900s and opened the canal finally in 1914. At the time and even up to modern standards, the canal was one of the most difficult engineering projects ever undertaken. The shortcut created by the canal enabled quick passage across the continent without having to travel down and around Cape Horn on the southernmost tip of South America.

When the canal was first constructed, about 1**,000 ships** per year traversed the system of locks. In modern times, over **14,000 vessels** travel through the canal every year. One of the most surprising facts about this engineering marvel is just how long it takes to traverse it. One ship takes 6 to 8 hours to get from one side to the other. The best way to visit this destination is by taking a cruise scheduled to cross the canal.

The Hoover Dam, USA

The Hoover Dam, while not one of the largest dams in the world is perhaps the most infamous. Constructed as a concrete arch-gravity dam on the Colorado River in Nevada and Arizona. Entire construction occurred from 1931 to 1936 under the direction President Roosevelt and during the Great Depression. Over 100 lives were lost during the construction of the dam with over **1000 workers** being involved in the total process.

An idea of placing a dam where the Hoover ultimately was built was formulated as far back as the early 1900s. Placing a dam where the Hoover is allowed irrigation control and hydroelectric power for the area. At the time, the Hoover Dam was the largest concrete structure ever created.

Nearly **1 million people** visit the dam each year. Part of the reason that visiting this dam is so great for engineers is because of where it sits in engineering history. While not presently anything to marvel over, the history surrounding the construction and documentation of the engineering places it at great importance to the history of engineering.

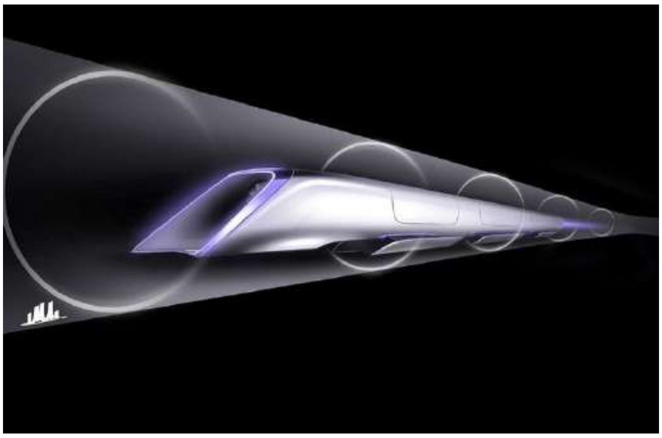
(Trevor English / Interesting Engineering, July 13, 2017, http://interestingengineering.com/top-engineering-destinations-to-see-before-you-die)

What is Elon Musk's Hyperloop? The 700mph subsonic train explained

- **Hyperloop is a high-speed train system**
- **Musk is planning two Hyperloop routes so far**
- **First one goes from LA to SF**
- **Second one will go from NY to DC**

Elon Musk has started the building revolution for a new train system.

Dubbed Hyperloop, it will allow you to get from London to Edinburgh or LA to San Francisco in under 30 minutes. But what is it and how does it work? Good questions. Musk has likened it to a vacuum tube system in a building used to move documents from place to place. Confused? No worries. Here's everything you need to know about the futuristic train coming from the founder of Tesla and SpaceX.



What is Hyperloop?

The Hyperloop is essentially a train that Musk calls "a cross

between a Concorde, a railgun, and an air hockey table". It's based on the very high-speed transit (VHST) system proposed in 1972, which combines a magnetic levitation train and a low pressure transit tube. It evolves some of the original ideas of VHST, but it still uses tunnels and pods or capsules to move from place to place.

Musk has likened it to a vacuum tube system in a building used to move documents from place to place.

How does Hyperloop work?

Air bearings or maglev

One of the biggest problems with anything moving is friction, both against surfaces and the environment the pod is moving through.

Hyperloop proposes to move away from traditional wheels by using air bearings for pods instead. This will have the pod floating on air. It's similar to maglev, in which the electromagnetic levitation of the train means there is no friction like a traditional train that runs on tracks. This is how current maglev trains can achieve super speeds, like the 500km/h maglev train in Japan.

Another proposal, from Hyperloop Transportation Technologies, uses passive magnetic levitation, meaning the magnets are on the trains and work with aluminium track. Current active maglev needs powered tracks with copper coiling, which can be expensive.

The Hyperloop will take this to the next level by traveling through low pressure tubes.

Low pressure

The Hyperloop will be built in tunnels that have had some of the air sucked out to lower the pressure. So, like high-altitude flying, there's less resistance against the pod moving through the tunnel, meaning it can be much more energy efficient, which is desirable in any transit system.

The original VHST proposed using a vacuum, but there's an inherent difficulty in creating and maintaining a vacuum in a tunnel that will have things like stations, and any break in the vacuum could potentially render the entire system useless. For Hyperloop, the idea is to lower the air pressure, a job that could be done by regularly placed air pumps.

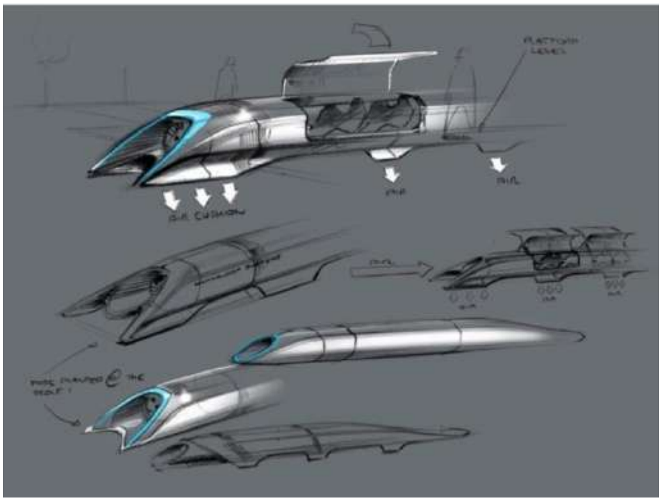
Low pressure, however, means you still have some air in the tunnels.

The air bearing and passive maglev ideas are designed not only to levitate the pod, but also see the pod moving through the air, rather than pushing the air infront of it and dragging it along behind. The air cushion will see the air pumped from the front of the pod to the rear via these suspension cushions. The tunnels envisioned are metal tubes, elevated as an overground system.

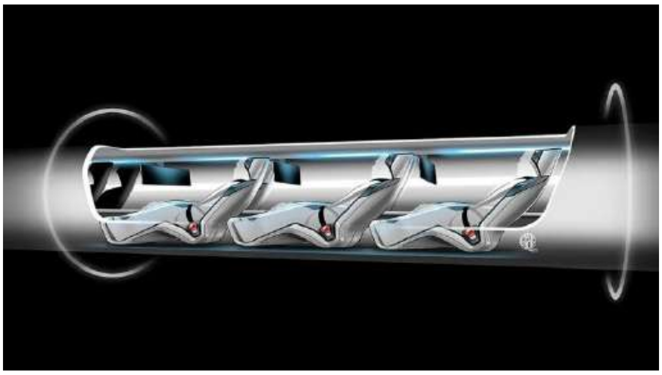
Musk has suggested that solar panels running on the top of the tunnels could generate enough electricity to power the system. It could run as an underground system, too.

What speeds are proposed?

Hyperloop is being proposed as an alternative to short distance air travel, where the system will be much faster than existing rail networks and much cleaner that flight. Hyperloop isn't about going as fast as possible, because you'll have to deal with high G forces when it came to turns, which isn't ideal for passenger travel. Speeds of over 700mph are suggested for journeys.



But there are practical implications that have to be considered on a short stop-start journey, such as the acceleration and deceleration sensation that passengers would go through.



When will the Hyperloop arrive?

Hawthorne test track

Musk hasn't yet given a date when we can expect to see Hyperloop up and running, he's merely announced that it will be made.

A one-mile test track built by SpaceX adjacent to Hawthorne, its California headquarters, has been built, and the first successful trial has been carried out. Hyperloop One plans to send an 8.5-metre long pod down a set of tracks in Nevada. In May 2017, a pod levitated a separate test track in Nevada for 5.3-seconds and reached 70mph.

LA to San Francisco

Planning documents currently propose a route between LA and San Francisco, a 354-mile journey, that would cost around $6 billion in construction. This is based on a passenger-only model, whereas one that can also transport vehicles would be $7.5 billion. This extra expenditure would be worth it since more people could use the system, offering potentially larger returns.

Shervin Pishevar, co-founder and chairman of Hyperloop Technologies, aims to shuttle passengers and cargo in high-speed pods that are smaller than most planes and trains and designed to depart as often as every 10 seconds. He recently told CNBC: "Hyperloop will be operational, somewhere in the world, by 2020."

New York to DC

Must tweeted in July 2017 that his Boring Company tunnel project has received "verbal [government] approval" to build a Hyperloop that would connect the cities of New York City, Philadelphia, Baltimore, and Washington, DC. He also tweeted more details about the project. The new Hyperloop would only take 29 minutes to travel between New York City and DC, Musk claimed.

It would feature "up to a dozen or more" access points via elevator in each city. Keep in mind Musk released his Hyperloop concept as an open-source white paper in 2013. As a result, Hyperloop Transportation Technologies is looking into a setup that would link Slovakia, Austria and Hungary. This is the same company that plans to create the five-mile test loop in California by 2018.

Musk has continually talked about his agitation with surface-level transportation. His tunnel project, dubbed the Boring Company, which began as a joke, is Musk's attempt at digging more efficiently. He's working on tunnel-boring machines than can both dig and reinforce tunnels, simultaneously. He also recently announced the completion of the first section of tunnel under Los Angeles.

Back to the "verbal govt approval": apparently, Musk's Boring Company will dig up the tunnel used for the New York-to-DC route. We've contacted the US Department of Transportation for more information. But based on Musk's tweets, we know work on the New York-to-DC Hyperloop will happen alongside the LA tunnel that's already in progress.

How much will Hyperloop cost?

According to Hyperloop Transportation Technologies CEO Dirk Ahlborn, the cost of a ticket should be around $30 mark to get a passenger from LA to San Francisco. That, he says, should allow the company to pay back its initial costs in eight years.

Whether this will actually be the price of a ticket remains to be seen.

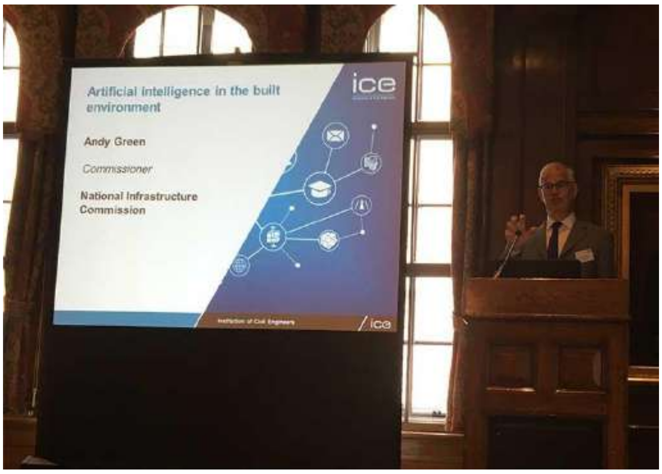
(Max Langridge and Elyse Betters / Pocketlint, 20 July 2017, http://www.pocket-lint.com/news/132405-what-is-elon-musk-s-hyperloop-the-700mph-subsonic-train-explained)

Driving innovation in infrastructure through artificial intelligence

Andy Green, Technology Commissioner from the National Infrastructure Commission, follows on from his recent ICE Thinks lecture on artificial intelligence in the built environment.

Whether City Mapper or Google Maps; Amazon's Alexa or Apple's Siri, artificial intelligence is fast becoming an integral part of people's everyday lives. The challenge over the coming years will be to exploit every possible opportunity that this new technology presents, and to keep up with the rapid pace of innovation and change to ensure the UK can be a world leader in this exciting field.

What do I mean by Artificial Intelligence? Lynne Parker, director of the division for information and intelligent systems at the National Science Foundation, describes this new technology as, "a broad set of methods, algorithms and technologies that make software 'smart' in a way that may seem human-like to an outside observer". For me, this includes machine learning, computer vision, natural language processing and robotics – but also such new innovations as Virtual Reality.



Artificial intelligence: need for the UK to keep up with pace of innovation.

As a country, we are particularly well-placed to be able to lead in this field, in the delivery and maintenance of our infrastructure and built environment. Some of the most innovative projects in this area are being developed right here in Britain: autonomous vehicles have been trialled in Greenwich and Milton Keynes; applications like Nest are controlling the temperature of our homes and offices, and drones are now being used to survey live construction sites.

As these technologies are used more often, the data available to us as to how they are used will also increase. This has already been critical in the development of significant projects: open data from the Environment Agency helps power Flood Alerts, an app offering 15-minute updates on flood warnings across the country; data from Transport for London has led to apps like City Mapper, and Manchester will soon offer a blueprint for Smart Cities of the future, thanks to the new City verve technology helping to identify how best to improve connections across neighbourhoods.

How can this technology be further exploited?

That's why the Government has tasked the National Infrastructure Commission to look into how this technology can be further exploited, and be used to improve the productivity of our infrastructure network. There are already a range of possibilities: they include improving the design of our infrastructure, to better influence the behaviour of its users; improving construction, by using robotics to perform tasks too dangerous for human beings; improving the management of our infrastructure, for example, by using intelligent traffic systems to ease congestions in cities; and improving how we maintain our infrastructure, by using data to predict when repairs will be required.

For our study, we're already working closely with organisations including Cambridge Centre for Smart Infrastructure and Construction, Alan Turing Institute and NESTA. But we'll also be focusing our efforts on four key examples:

- Better asset management – looking at how technology can improve the maintenance of our infrastructure;
- Water efficiency – working with water companies to examine how technology is helping address problems such as leakages;
- Active traffic management – looking at smart traffic systems to tackle congestion and improve traffic flow; and
- Big Data – examining the issues around the collection, management, use and sharing of data underpinning, and generated by, the use of artificial intelligence

This is an area that is exciting people from across a range of different professions, and I was really encouraged by the discussion in response to my James Forrest lecture on the issue, and at the following workshop hosted by the Institution of Civil Engineers. This is just the start of the dialogue on how we can use AI to improve the way we create and deliver. Very shortly, we'll be publishing a call for evidence, and I would encourage people to come forward with their views, whether in writing or at one of our dedicated events.

We plan to come forward with our recommendations by the end of the year – all of which will be designed to ensure we can make the best possible use of both the artificial intelligence technology available now, and capitalise on innovations in the future.

The revolution is only just beginning: I have been urging all the companies I work with to have a corporate strategy for the digital age, not a digital strategy, for many years now.

More recently I have been urging them to have a mobile-first strategy. I am now pondering the wisdom of suggesting that companies have an AI-first strategy. Even at this early stage of the technology and of our research, the case for this approach appears to be strong.

Watch the webinar recording

(Andy Green, Commissioner - National Infrastructure Commission, 25 July 2017, https://www.ice.org.uk/news-and-insight/ice-thinks/infrastructure-transformation/driving-innovation-in-infrastructure?feed=ice-thinks)

A Team of Scientists Just Made Food From Electricity — and it Could be the Solution to World Hunger

IN BRIEF

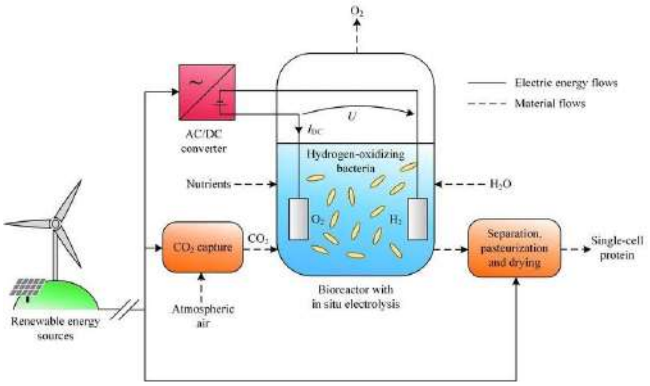
A Finnish research team has taken a step towards the future of food by developing a method for producing food from electricity. If scaling it up proves to be successful, it could be a tool in the fight against world hunger and climate change.

THE ELECTRIC BIOREACTOR FARM

Finnish researchers have created a batch of single-cell protein that is nutritious enough to serve for dinner using a system powered by renewable energy. The entire process requires only electricity, water, carbon dioxide, and microbes. The synthetic food was created as part of the Food From Electricity project, which is a collaboration between Lappeenranta University of Technology (LUT) and the VTT Technical Research Centre of Finland.

After exposing the raw materials to electrolysis in a bioreactor, the process forms a powder that consists of more than 50 percent protein and 25 percent carbohydrates — the texture can also be changed by altering the microbes used in the production.

The next stage, according to Juha-Pekka Pitkänen, principal scientist at VTT, is to optimize the system because, currently, a bioreactor the size of a coffee cup takes around two weeks to produce one gram of the protein. Pitkänen said in a LUT press release, "We are currently focusing on developing the technology: reactor concepts, technology, improving efficiency, and controlling the process."



He predicted that it would take about a decade before a more efficient incarnation of the system would be widely available — "Maybe 10 years is a realistic timeframe for reaching commercial capacity, in terms of the necessary legislation and process technology."

A WORLD WITHOUT HUNGER

The potential impact of food produced using electricity and other widely available raw materials is enormous. Currently, there are two main ways that it could be used.

First, as a means of feeding starving people and providing a source of food in areas that are not suited to agricultural production. Pitkänen said that, in the future, "the technology can be transported to, for instance, deserts and other areas facing famine," providing a source of cheap and nutritious food to those who need it most.

The machine also works independently of environmental factors, meaning that it could feed people consistently — Jero Ahola, a Professor at LUT, said in the press release that it "does not require a location with the conditions for agriculture, such as the right temperature, humidity or a certain soil type."

Second, as a means of decreasing global emissions by reducing the demand for food livestock and the crops necessary to feed them. Currently, the meat industry accounts for between 14 and 18 percent of global emissions of greenhouse gases, as well as taking up swarths of land that could be applied for other ends.

The food from electricity project could decrease the amount of unsustainable farming needed to fill our bellies as it provides us with a smaller, cheaper, and renewable method of getting our nutrients. Other solutions to this problem include lab-grown meat or turning to insect farming, which produces less waste and requires less energy.

References: New Atlas, Phys.org, LUT

(Tom Ward / Futurism, July 26, 2017, https://futurism.com/a-team-of-scientists-just-made-food-from-electricity-and-it-could-be-the-solution-to-world-hunger)

Πεζοπόροι στο κενό
Ιλιγγιώδης περίπατος στη μακρύτερη κρεμαστή πεζογέφυρα του κόσμου

Έχετε όρεξη για καθαρό αέρα και πεζοπορία στα βουνά; Τολμήστε να διασχίσετε την «μακρύτερη κρεμαστή πεζογέφυρα του κόσμου», η οποία μόλις εγκαινιάστηκε στο Τσαρμάτ της Ελβετίας.

Ο στενός διάδρομος της Europabrücke (Γέφυρα της Ευρώπης) έχει μήκος 494 μέτρα και αιωρείται μέχρι τα 85 μέτρα πάνω από το φαράγγι Γκράμπενγκουφερ, προσφέροντας μοναδική θέα στο όρος Μάττερχορν.

Αντικαθιστά μια προηγούμενη γέφυρα για πεζοπόρους που καταστράφηκε σε κατολισθήσεις, και είναι στερεωμένη στο έδαφος με τεντωμένα συρματόσχοινα ώστε να μην ταλαντώνεται.

Σύμφωνα με τον Τουριστικό Οργανισμό του Τσαρμάτ, η Europabrücke κερδίζει τον τίτλο της μακρύτερης του είδους της. Δεν είναι όμως και η υψηλότερη -σύμφωνα με το BBC, το ρεκόρ αυτό κατέχει μια γέφυρα στο Ρόιτε της Αυστρίας που έχει μήκος 405 μέτρα και κρέμεται 195 μέτρα από το έδαφος.

(Newsroom ΔΟΛ, 29 Ιουλ 2017, http://news.in.gr/perierga/article/?aid=1500156994)

From the ground up - improving the delivery of big infrastructure projects and programmes

Leading infrastructure and industrial companies recently joined an event about using better production processes and systems to improve the delivery of projects.

What are the characteristics of the capable infrastructure owner?

The purpose of the Project 13 discussion was to share experiences for improving delivery of projects and programmes for the benefit of clients and customers.

In particular, the discussions focused on the evidence of using established technologies, new business models and creating the conditions that enable companies and people from different backgrounds to work together more effectively.

6 characteristics of the capable infrastructure owner

Much was said about the characteristics of capable infrastructure owners that enable them to develop these new approaches in collaboration with their suppliers.

1. An imperative for change and leadership

Infrastructure owners must recognise the need to change the ways in which they deliver their projects and programmes in order to achieve better results and improve efficiency and productivity.

The next step is to demonstrate a willingness to use innovative approaches and technologies to make these improvements. It is also important that infrastructure owners are able to develop an ethos across their organisations for continuously improving the way in which programmes and projects are delivered.

2. Upfront problem definition and solution design

Too often infrastructure owners commit to projects before they have adequately defined the problem they are trying to solve. For example, HS2 has been developed as a solution for cutting journey times between the north and south. But arguably the need to better connect people and markets, create jobs and drive economic growth are the more pressing challenges. Had the problem been defined in these terms from the outset it is possible that different solutions would have emerged.

It was agreed that we can learn from companies like GSK that have put in place formal processes for challenging and defining the problem to be solved before committing resources to designing a project.

3. Outcome value vs lowest cost procurement

Leading industrial and infrastructure companies must begin to measure project value within the context of the expected results by investing in the project. This initial focus will then follow through to the way in which design and procurement of contracts are undertaken. Contracts are awarded to bidders who demonstrate the best way of achieving a set of outcomes instead of the lowest cost to deliver a particular design.

It was recognised that particularly in the public sector there are barriers to procuring projects in this way. We need to develop new approaches to governance that support a value-driven procurement process.

4. An enterprising culture

From the outset infrastructure owners should do more to engage design consultants, contractors and suppliers on what they hope to achieve. Developing a shared vision will increase the chances of successful delivery.

This means building a collaborative planning culture, holding regular project team meetings to review delivery against the agreed outcomes and undertaking an effective appraisal at project completion.

5. Exploit the digital environment

The more effective use of established technologies in delivering projects and programmes will enable significant efficiency gains and boost productivity. At present this is not happening consistently across the infrastructure and industrial sectors.

For example, the use of BIM in many infrastructure projects is restricted to laying out project design rather than to aid delivery. This actually increases costs. We need to develop approaches to using BIM that support new ways of working and new business models.

This will require much better information about existing assets, standard products and components in a digital format.

6. Productisation of construction processes

There are opportunities from developing sets of standard products for critical elements of their infrastructure – in particular those that repeat from project to project.

Technologies like BIM will enable infrastructure owners to invest in standard solutions or products that incorporate all of the learning from their previous projects. Over time this approach should enable infrastructure owners to develop a virtual library of high value products for use across a range of future projects and programmes.

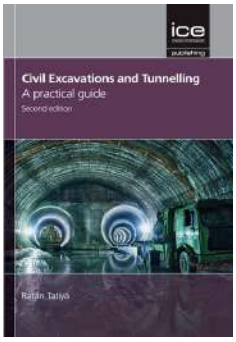
Organisations at the meeting

Acumen 7, Anglian Water, Bosch, Bryden Wood, DEKA, Dees & Sommer, GSK, Highways England, ICE, Mace, Ministry of Justice, UK Power Networks, Wessex Advisory.

The discussions were held under the Chatham House Rule.

(Ben Goodwin, ICE Policy Manager 31 July 2017, https://www.ice.org.uk/news-and-insight/ice-thinks/infrastructure-transformation/from-the-ground-up-improving-the-delivery-of-big?feed=ice-thinks)

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ



Civil Excavations and Tunnelling
A Practical Guide
Second edition

Ratan Tatiya

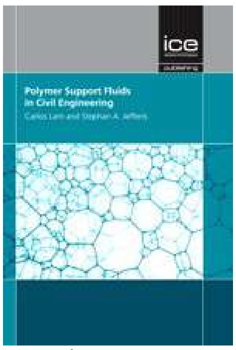
Civil Excavations and Tunnelling is a comprehensive guide to civil excavations at surface and subsurface levels, with or without the aid of explosives. It features descriptions of the latest methods, techniques, equipment, trends and practices, as well as guidance on safety and the environment.

Civil Excavations and Tunnelling, Second edition:

- serves as a single point of extraction of multiple data for earthworks
- comprises numerous case studies to illustrate the challenges posed by different types of soil, as well as the pros and cons of different sets of equipment
- details the recent innovations in tunnel boring machines (TBMs), including crossover, variable density and multi-mode TBMs
- includes key points and learning questions that allow readers to test their knowledge
- highlights best practices, sustainability in operations, loss-prevention strategies, and occupational health, safety and environment issues

Excavation is a multi-disciplined activity involving civil, construction and mining professionals, earth scientists and geologists. This book will appeal to practitioners, researchers and students in these disciplines.

(ICE Publishing, 27/07/2017)



Polymer Support Fluids in Civil Engineering

Carlos Lam and Stephan Jefferis

Polymer Support Fluids in Civil Engineering provides a detailed study of the use of polymer support fluids in civil engineering, covering all major aspects including fundamental material properties, laboratory and site testing, as well as case histories and specifications. This book includes all the information necessary to optimise the use of polymer support fluids and the performance of the resulting foundation elements.

The opening chapters describe the development of polymer fluid technology, including the various types of commercial polymer system currently available and the constraints on the use of bentonite support fluids. They are followed by chapters on site equipment and procedures, and laboratory and site techniques for assessing the physical and chemical properties of polymer fluids. Two chapters are then dedicated to detailed reviews of published case histories from around the world with analysis of successes, and importantly, possible reasons for failures that have occurred. The book concludes with a critical review of the specifications for the use of polymer fluids and a discussion of the rationale for the selection of the control parameters.

Written by two experts in this area, *Polymer Support Fluids in Civil Engineering* is the first book on the use of polymer support fluids in the construction industry. It will be an invaluable and authoritative reference for practitioners, researchers and advanced students working in geotechnical engineering.

(ICE Publishing, 24/11/2017)

Contaminated Land Guidance, Third edition

Jo Strange, Nick Langdon and Alex Large
CGL UK

Contaminated Land Guidance provides authoritative guidance and up to date information to on the challenges associated with contamination on brownfield developments.

This fully updated edition summarises the key elements of current regulations and good practice as published in existing authoritative guidance documents prepared by key organisations such as central government, the Environment Agency, the Construction Industry Research and Information Association (CIRIA) and the Building Research Establishment (BRE). In addition, changes to waste management legislation have resulted in an increased focus on sustainable development along with the implementation of sustainable remediation solutions.

It recognises the whole area of contaminated land investigation and remediation has undergone significant changes since 1994 and the subsequent second edition in 2007 and will continue to do so for the *foreseeable future.*

Contaminated Land Guidance:

- provides a clear overarching route map for current and best practice
- reflects the recent changes in the field of contaminated land, including government statutory guidance, CDM regulations, clarifying different types of receptors, environmental permitting and background concentrations of contaminants
- includes a summary of key watch points and steps required to manage contaminated sites

• offers a range of case studies that showcase examples of practical cost effective solutions.

As redevelopment of brownfield land becomes the norm as a result of lack of developable space, assessment of contamination becomes a material issue, both in terms of environmental risks and financial liabilities for most sites.

Contaminated Land Guidance, Third edition is essential reading for professionals dealing with regeneration of contaminated land, including civil and structural engineers, incoming contaminated land professionals at graduate level, project managers, planning consultants, surveyors, conveyancers, architects, property developers, portfolio managers and site managers.

(ICE Publishing, 24/10/2016)

Crossrail Project: Infrastructure Design and Construction - Volume 3

Edited by Mike Black

The construction of the Crossrail project began at North Dock in Canary Wharf in May 2009. Seven years on, it is the biggest railway construction project in Europe and is one of the largest single infrastructure investments undertaken in the UK. It consists of 21 km of new twin-bore tunnels under central London and 10 new world-class stations constructed under the largest city in the European Union.

Crossrail Project: Infrastructure Design and Construction (Volume 3) contains a collection of 34 papers submitted to Crossrail's Technical Papers Competition between 2014 and 2015. Contributions have come from consultants, contractors, suppliers and third-party stakeholders involved in design and construction across the Crossrail project. The papers cover a multitude of disciplines including Ground Engineering, Sprayed Concrete Lining, Tunnel Boring Machine Tunnelling, Engineering Geology, Geotechnical Monitoring and Mitigation, Architectural Design, Operations and Logistics.

As part of Crossrail's legacy, it is incumbent upon the organisation to share its experiences and best practices with the rest of the industry and to showcase the skills of the personnel involved and the successful delivery of each phase of works. This third volume is the culmination of that experience.

Crossrail Project: Infrastructure Design and Construction provides a valuable source of reference for current practices in design and construction of large-scale underground projects.

(ICE Publishing, 31/08/2016)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.geoengineer.org

Κυκλοφόρησε το Τεύχος #146 του **Newsletter του Geo-engineer.org** (Ιουλίου 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:

- Tsunami waves leave 4 people dead in Greenland (video)
- The fascinating geology of Myanmar's Mergui Archipelago
- California is blowing up Oroville Dam's spillway in order to replace it
- Scientists in search for hints about Caribbean earthquakes
- Massive landslide buries part of California highway (video)
- Greek village evacuated after huge mining-induced landslide (video)
- Deadly landslide occurs in Sichuan province, China
- Large earth crack opens in Manipur, India

http://campaign.r20.constantcontact.com/render?m=1101304736672&ca=57f55146-68c7-49db-bd68-926b8f73b5b8

International Society for Rock Mechanics
ISRM
NEWSLETTER

https://www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=140&ver=1

Κυκλοφόρησε το Τεύχος No. 38 (Ιουνίου 2017) του ISRM Newsletter με τα ακόλουθα περιεχόμενα:

- Message from the President
- 18th ISRM Online Lecture by Professor Marc Panet
- Welcome to Cape Town, to the 2017 ISRM International Symposium - AfriRock 2017, 2-7 October
- Volume 19 - December 2016 of the ISRM News Journal is now online
- The 2018 ISRM International Symposium - ARMS10, 29 Oct. - 3 Nov.
- European Rock Mechanics Symposium - Eurock 2018, Saint-Petersburg, Russia, 22-26 May
- GeoProc 2017, Paris, France, 5-7 July, an ISRM Specialised Conference
- 3rd Nordic Rock Mechanics Symposium - NRMS 2017, Helsinki, Finland, 11-12 October, an ISRM Specialised Conference
- Shaoxing International Forum on Rock Mechanics and Engineering Geology (SXFRG),Shaoxing, China, 28-29 October 2017, an ISRM Specialised Conference
- Report on YSRM 2017 & NDRMGE 2017, Jeju, Korea
- Report on the 51st US Rock Mechanics/Geomechanics Symposium
- ISRM Rocha Medal 2019 - nominations to be received by 31 December 2017
- ISRM Sponsored meetings

https://www.isrm.net/gca/?id=206

Ο Τόμος 19 του ISRM News Journal περιέχει και τα παρακάτω πολύ ενδιαφέροντα άρθρα:

- **Micro Mechanical Rock Models** του Heinz Konietzky | Prof. Dr.-Ing. Habil., Geotechnical Institut, TU Bergakademie Freiberg, Germany - FRANKLIN LECTURE
- **The Secrets of Jointed Rock Masses as Told by Distinct Element Models: Jointed Roof Beams, Ground Support Design and the 1963 Vajont Rock Slide** του Chia Weng Boon, Gamuda Engineering Sdn Bhd, Kuala Lumpur, One Smart Engineering Pte Ltd, Singapore - ROCHA MEDAL LECTURE
- **Underground Rock Engineering to Match the Rock's Behaviour – Challenges of Managing Highly Stressed Ground in Civil and Mining Projects** του Peter K. Kaiser | Emeritus Professor, Laurentian University, Sudbury, Ontario, Canada - MTS LECTURE

International Journal of Geoengineering Case Histories

Vol. 4 / Issue 2
www.geocasehistoriesjournal.org/pub/issue/view/39

Geotechnical Damage Caused by the 2016 Kumamoto Earthquake, Japan by Takashi Kiyota, Takaaki Ikeda, Kazuo Konagai, Masataka Shiga

A High Rock Cut Stabilization in Muscat City, Oman by Tahir M. Hayat, Tariq J. Bhatti, Robert Goldsmith

St. Isaac Cathedral (St. Petersburg, Russia): A Case History by Anna Shidlovskaya, Jean Louis Briaud, Mehdi Mohammadrajabi

Uplift of an Underground Tank in Northern Malabar Region, India by Nilesh P. Shirode, Kedar C. Birid, S. R. Gandhi, Rajesh Nair

Vol. 4, Issue 3
http://www.geocasehistoriesjournal.org/pub/issue/view/41

Performance of CAPS Method Considering its Interaction with Adjacent Structures – The Q7 Station of Tehran Metro Line 7 by Behnam Eslami, Aliakbar Golshani

Geotechnical and Structural Challenges over an Active Landslide by Konstantinos Seferoglou, Isabella Vassilopoulou, Fragiskos Chrysohoidis

www.geosyntheticssociety.org/wp-content/uploads/2017/04/IGS-News-Vol.-33-Issue-1.pdf

Κυκλοφόρησε το Τεύχος 1 του Τόμου 33, 2017 του Newsletter της International Deosynthetics Society με τα παρακάτω περιεχόμενα:

Volume 24, Issue 1, February, 2017
www.icevirtuallibrary.com/toc/jgein/24/1

Analytical method for calculating natural frequencies of geosynthetic-reinforced wall with full-height concrete facing, M. S. Ramezani, A. Ghanbari, S. A. A. Hosseini, 24(1), pp. 1–13

Deterministic and probabilistic failure analysis of simple geosynthetic reinforced soil slopes, S. Javankhoshdel, R. J. Bathurst, 24(1), pp. 14–29

Investigation of the micro-mechanics of sand–rubber mixtures at very small strains, J. C. Lopera Perez, C. Y. Kwok, K. Senetakis, 24(1), pp. 30–44

Three-dimensional analysis of geosynthetic-encased granular columns for liquefaction mitigation, L. Geng, L. Tang, S. Y. Cong, X. Z. Ling, J. Lu, 24(1), pp. 45–59

Time-dependent behaviour of fully and partially penetrated geosynthetic encased stone columns, S. Rajesh, 24(1), pp. 60–71

Experimental study on the combined application of vacuum preloading – variable-spacing electro-osmosis to soft ground improvement, H. Fu, Y. Cai, J. Wang, P. Wang, 24(1), pp. 72–81

Physical and hydraulic response of geomembrane wrinkles underlying saturated fine tailings, P. Joshi, R. K. Rowe, R. W. I. Brachman, 24(1), pp. 82–94

Tensile behaviour of an HDPE geogrid under cyclic loading: experimental results and empirical modelling, G. Cardile, N. Moraci, M. Pisano, 24(1), pp. 95–112

Book review, R.J. Bathurst, 24(1), pp. 113

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www.icevirtuallibrary.com/toc/jgein/24/2

Model tests on the bearing capacity of reinforced saturated sand ground, C. C. Huang, 24(2), pp. 114–124

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New insight on geosynthetic clay liner hydration: the key role of subsoils mineralogy, A. Bouazza, M. A. Ali, W. P. Gates, R. K. Rowe, 24(2), pp. 139–150

Surface topographical analysis of geomembranes and sands using a 3D optical profilometer, P. Vangla, G. M. Latha, 24(2), pp. 151–166

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Degradation of polypropylene woven geotextile: tensile creep and weathering, M. G. A. Guimarães, D. de Mattos Vidal, D. de Carvalho Urashima, C. A. C. Castro, 24(2), pp. 213–223

Volume 24, Issue 3, June, 2017
www.icevirtuallibrary.com/toc/jgein/24/3

Influential factors affecting drainage design considerations for mechanical stabilised earth walls using geocomposites, A. Chinkulkijniwat, S. Horpibulsuk, D. Bui Van, A. Udomchai, R. Goodary, A. Arulrajah, 24(3), pp. 224–241

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Pullout resistance mechanism of bearing reinforcement embedded in residual clayey soils, S. Horpibulsuk, A. Udomchai, A. Joongklang, A. Chinkulkijniwat, N. Mavong, A. Suddeepong, A. Arulrajah, 24(3), pp. 255–263

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A study on containment of heavy metals using soils and cellulose materials inside geotextile tubes, P. Rupakheti, S. K. Bhatia, 24(3), pp. 321–332

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www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/45/issue/1

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www.sciencedirect.com/journal/geotextiles-and-geomembranes/vol/45/issue/2

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Κυκλοφόρησαν τα Τεύχη # 15 (Μαΐου 2016) και # 16 (Μαρτίου 2017) των Newsletters της International Committee on Large Dams

The Dams Newsletter
May 2016 #-15

www.icold-cigb.net/article/GB/news/newsletters/newsletter-15

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ΕΕΕΕΓΜ

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