Canyoning στο Φαράγγι των Κενταύρων Α Πήλιο

Αρ. 114 – ΜΑΙΟΣ 2018

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

114

Can the building industry break its addiction to concrete?

Concrete: we can't live with it, can't live without it. A combination of cement, water and ground rock or sand, on the surface concrete might seem crushingly mundane. Yet it has defined construction in recent centuries and with it, in part, modernity.

But do we need to re-evaluate our concrete habit for our sakes and the planet's? Production of cement is disastrous for our biosphere, while the degradation of many concrete buildings has some construction experts predicting a colossal headache in the future.

There are myriad proposed solutions, such as changing the way we make concrete, creating sustainable alternatives or doing away with it altogether. But would we want to live in a world without concrete? And what would that world look like?

(συνέχεια στην σελίδα 3)

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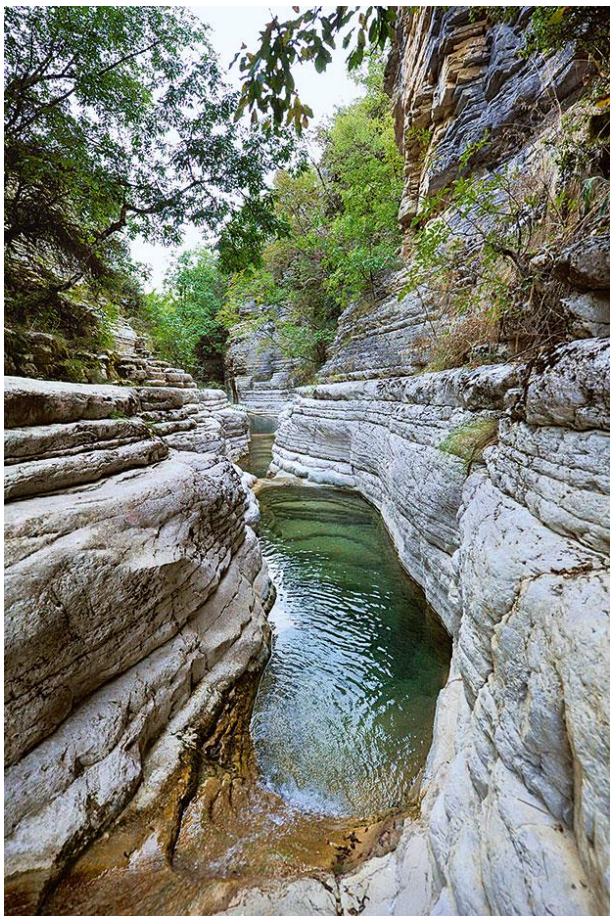


Οι Κολυμπήθρες στο Ζαγόρι

Πεζοπορία στα καλντερίμια της Τσαγκαράδας

(συνέχεια από την πρώτη σελίδα)

The Great Wall of WA, Western Australia
Composed of iron rich, sandy clay, the building is constructed with a 230-meter-long rammed earth wall. It only took a small amount of steel and concrete to build

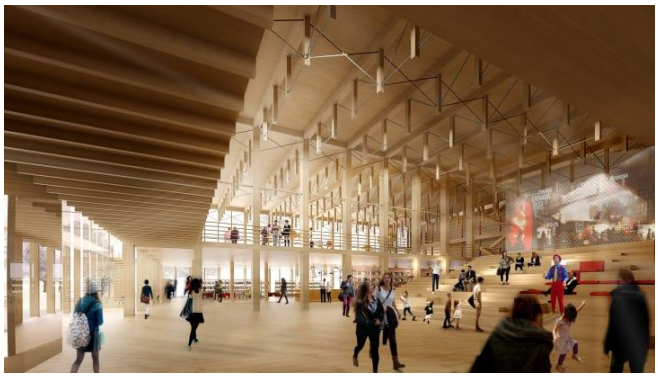
"If it ain't cracked, it ain't concrete"

"We make more concrete than anything else, any other product, apart from clean water," says Paul Fennell, professor of clean energy at Imperial College London. One 2015 report estimates that each year approximately three tons of concrete are used for every person on Earth -- roughly, 22 billion tons. To put that in context, a recent study estimated that 8.3 billion metric tons of plastic have been produced, ever.

The Wood Innovation and Design Center, British Columbia, Canada
This six-story building with a ground floor mezzanine and a rooftop mechanical penthouse won the 2016 Governor General's Medal in Architecture. Designed with CLT floor panels, Glulam beams and mass timber walls, there is no concrete used in the building above the ground floor slab.

Manufacturing cement, concrete's binding agent, is energy-intensive, Fennell says. Ordinary Portland cement -- the most common form in concrete -- is produced by baking lime in a kiln and emits approximately one ton of carbon dioxide for every ton of cement. Cement production is responsible for approximately 5% of global man-made CO2 emissions, according to the World Business Council for Sustainable Development.

Cement does absorb some carbon dioxide back from the atmosphere over time, Fennell notes. One 2016 study estimated that between 1930 and 2013, the equivalent of 43% of CO2 released from lime during heating was reabsorbed by concrete products worldwide -- although that percentage does not include carbon dioxide emitted by the fossil fuels burned to heat kilns, a significant contributor of CO2 emissions during production.



The Wood Innovation and Design Center, British Columbia, Canada
With a height of 29.5 meters, the lower levels are occupied by the University of Northern BC's wood design program while the upper levels are office spaces for organizations associated with the wood industry.

Unfortunately, this absorption comes at a price, particularly when cement is used in structures that feature steel reinforcement bars (rebar) within concrete.

BskyB Believe in Better Building, London
Designed for the BskyB's outreach and training program, the building was completed in less than a year according to ARUP Associates. Constructed with solid timber frame, the 3,000-square-meter, four-story building features a restaurant and roof terrace.

Windhover Contemplative Center, Stanford University
Designed for California's Stanford University in 2014, this 370-square-meter building serves as a spiritual retreat for the institution.

"(As) CO2 moves through cement it changes the pH of the surroundings," Fennell says. Concrete loses its alkalinity and, when moisture and oxygen are present, causes the rebar to rust.

"Rusting steel can expand with great force to as much as nine times its original dimensions if you add up all of the layers of iron oxide," says Randolph Langenbach, an international consultant in building conservation. This expansion causes the concrete to crack, flake and crumble.

Windhover Contemplative Center, Stanford University
With a private garden surrounded by tall bamboo, the building is constructed by thick-rammed earth walls and dark wood surfaces. The thick rammed earth wall were made of soil excavated from the site.

"Rusting steel can expand with great force to as much as nine times its original dimensions if you add up all of the layers of iron oxide," says Randolph Langenbach, an international consultant in building conservation. This expansion causes the concrete to crack, flake and crumble.

Sida vid sida, Skelleftea, Sweden
Also known as "side by side," this 19-story structure will be located in the Swedish city of Skelleftea. The building is expected to be the tallest wooden building in the Nordic countries.

Degradation is a massive concern, he argues, and problems are not limited to rusting rebar. Everything from air pockets left in the concrete mix when it's laid, to salt air buffeting coastal-facing walls, or the use of beach sand in the concrete, can shorten a building's lifespan.

As one specialist once put it to Langenbach: "If it ain't cracked, it ain't concrete."

A conservative industry

Given the concerns about the environmental impact and structural longevity of concrete, why do we continue to build with it?

Treet, Bergen, Norway
The Treet is a 14-story luxury apartment in Norway. With a focus on energy consumption and sustainable development. The building comprises a mix of cross-laminated timber and glulam, built on concrete ground floor.

Forte, Melbourne, Australia
Made from cross-laminated timber (CLT), it is a 32.2-meter-high, 10-story apartment block. It is also the first Australian building to be made from CLT.

Simply put, concrete is cheap, versatile, quick to erect and requires no addition fireproofing. It's also a known entity, and that carries a lot of weight. So-called "novel" cements, some with "greener" formulas, have been developed, but radical changes to industry standards are likely to be met with caution by constructors, Fennell argues.

River Beech Tower, Chicago, United States
The River Beech Tower is a residential skyscraper designed by architect Perkins+Will. The architect plans to construct the building with entirely timber elements by taking advantage of the natural strength of wood. The 80-story tower will feature 300 duplex units.

"If you want to build the next Burj Khalifa, you're not going

to get any of these new types of cement in there for a long time," says Fennell, "because people don't know how they will stand up to 20 or 30 years' worth of degradation." A 2017 report commissioned by the UK government failed to identify any publicly available lifecycle studies focusing on novel cements, for instance.

Green Village, Bali, Indonesia
Recognized as one of Bali's most sustainable housing solutions, the villas and house in the Green Village are constructed almost entirely from bamboo.

Langenbach has a more skeptical take. "Making concrete (...) is a huge business, so much so that it's sort of become identified as the mafia -- at least in this country (the US)." Historically, there have been connections to the New York mob, and there's certainly still money to be made. The USGS estimates cement sales for concrete in 2017 were "worth at least $65 billion" in America alone.

Green Village, Bali, Indonesia
Located near the hill town of Ubud, the bamboo villas consist of 18 homes. Each house also features high-end bathroom and kitchen fittings.

Bamboo Sports Hall Panyaden School, Changmai, Thailand
The lotus flower shaped structure is a sports hall made with Bamboo for the Panyaden International School. The whole school was built only with natural material to bring students closer to nature.

Something old, something new

Some architects are trying to solve the concrete problem by pursuing more sustainable materials -- both old and new.

Californian firm Aidlin Darling Design prides itself on its ethical architecture, and co-designed the Windhover Contemplation Center, an award-winning spiritual refuge at Stanford University built with colossal rammed earth walls.

Lagos's Wooden Tower (concept), Lagos, Nigeria
This experimental wooden structure in Lagos was developed with natural, recyclable and local materials. The roof features of a restaurant and sky garden.

Trulli, Italty
Trullo is a traditional Apulian dry stone house with a conical roof -- the tiny white dome is unique in Italy and constructed with small stones. With the oldest Trulli located at Alberobello, the house dates back to the 14th century when concrete wasn't used. The building is one of the 53 UNESCO World Heritage Sites in Italy.

Rammed earth is a combination of unbaked materials -- such as gravel, sand and clay -- and locally-sourced earth, compressed within a frame, has been used as a building material for thousands of years. Recently, it has experienced a revival in high-end construction.

"It's art and science all in one," says partner Joshua Aidlin, describing the low-impact material. Windhover's walls are 24 inches thick and "ended up being denser than many of our concrete walls," says Aidlin -- but notes that there were "hurdles" in having the building approved by authorities, because they weren't familiar with it.

A cement factory obscured by heavy smoke in Binzhou, Shandong province, China, pictured in January 2013.

The reprisal of old -- sometimes ancient -- building materials and techniques could be crucial for sustainability. Langenbach specializes in post-earthquake surveying and disaster recovery. He says vernacular architecture -- specific to residents' needs and utilizing local building resources -- is often highly resilient, citing 700 to 1,000-year-old unfired clay construction in Iran that has withstood serious tremors while newer buildings collapsed.

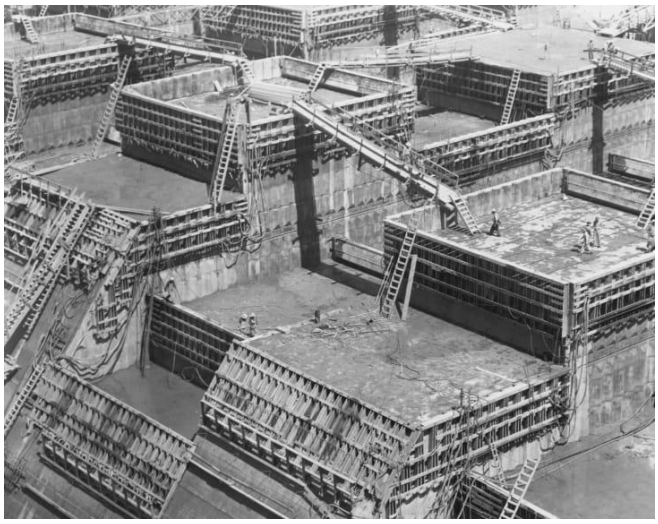
Oakwood Tower, London, United Kingdom
This 300-meter-tall wooden skyscraper is proposed by PLP architecture and Cambridge University's Department of Architecture. If built, the tower would feature up to 1,000 new homes.

Haiti's 19th and 20th century "gingerbread houses" provide another example, Langenbach adds. Those built with the "colombage" -- or half-timber -- system fared particularly well in 2010's devastating earthquake, he says. The Oloffson Hotel, a famous Gothic-style Gingerbread mansion built with unreinforced brick masonry, remained operational when the rest of the country ground to a halt.

A sea wall in Naples Island, California shows signs of degradation. Salt air is one of a number of factors that can shorten the lifespan of concrete.

However, Evan Reis, a structural engineer and executive director of US Resiliency Council, says that statistics show that concrete structures are far better at withstanding earthquakes than unreinforced brick buildings.

He argues that concrete's resiliency to natural disasters also contributes to its sustainability.



Workers pour concrete in the US, circa 1940.

"Concrete has been shown to be very resilient to earthquakes, hurricanes, floods, fires, and if you're looking at sustainability in the long term, you have to look at how likely a building is to survive those disasters," he told CNN.

Windhover Contemplative Center, California.

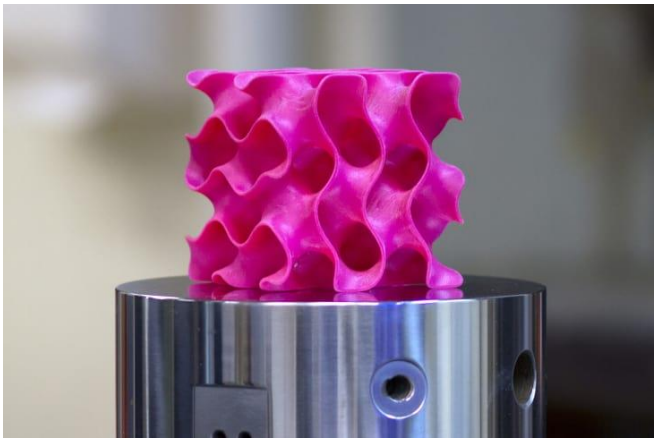
One of Port-au-Prince's "gingerbread houses" in 2015. Research shows they were resilient to the impact of 2010's earthquake.

"If a building is damaged and has to be demolished then there's an environmental cost in the energy required to demolish the building, to haul the stuff to a landfill and to replace the destroyed building. So it's not all about the initial environmental cost of the building, it's the long-term value of the building.

"If you have to replace a building multiple times over 50 or 100 years, how green is it in in the end?"

A more sustainable concrete?

A Japanese design firm has injected silica with carbon dioxide to produce a purportedly carbon-negative building material; a Dutch team is experimenting with "living" concrete that self-heals; "C02NCRETE" made with "upcycled" carbon dioxide has been developed in the UK; hemp and lime have been combined to produce "Hempcrete"; and Enviroblocks have been produced from recycled aggregates. Various materials that incorporate graphene -- the world's strongest material -- are also being developed.



Graphene flakes fused into a super-strong gyrioid shape. Multiple studies have proposed the use of graphene in high-strength concrete and cement.

Such high-tech solutions sound promising, but the road to mainstream acceptance is littered with alternatives that never stuck -- either because they couldn't scale up or make their bottom line work. Perhaps producing and using concrete in a more sustainable way is the answer?

"Cement is key to modern society," says Fennell. "We need to work out a way to make it more sustainable at source." The cement industry, he adds, has been reducing its CO2 emissions by burning biogenic waste -- organic materials such as agriculture by-products -- in cement kilns.

Project LEILAC (Low Emissions Intensity Lime and Cement) is a European initiative that is developing technology to capture and store the carbon dioxide produced by cement production -- rather than release it into the atmosphere. Fennell says carbon capture techniques, combined with alternative fuels, could help achieve an EU target of cutting emissions to 80% below levels recorded in 1990 by 2050.

The Pantheon in Rome. Built with unreinforced concrete, its dome is still standing nearly 2,000 years later.

Increasing the lifespan of concrete buildings would also ease the burden. Concrete *can* withstand the ravages of time if applied correctly. The Pantheon in Rome, which boasts the world's largest unreinforced concrete dome, has stood for nearly 2,000 years. But few modern structures can match this engineering marvel.

A difficult question

So can we really live without concrete? Langenbach is not optimistic. "We have built so many reinforced concrete structures, and are continuing to build them, probably for the next 75 to 100 years more, particularly in China," he says. "These buildings are almost all likely to have to be replaced or undergo significant structural repairs to their reinforced concrete frames within 50 to 150 years. Your eyes grow wide when you think of the scale."

Aidlin has similar reservations. "It's the quickest, the easiest (material) to build with," he says, particularly in parts of the developing world and where resources are scarce. "But I would never say never," he offers, more in hope than expectation.

For the moment, at least, it feels like concrete is here to stay -- even if most of the buildings made with it are not.

(Thomas Page / CNN, 4th May 2018, https://edition.cnn.com/style/article/concrete-alternatives-future-building/index.html)

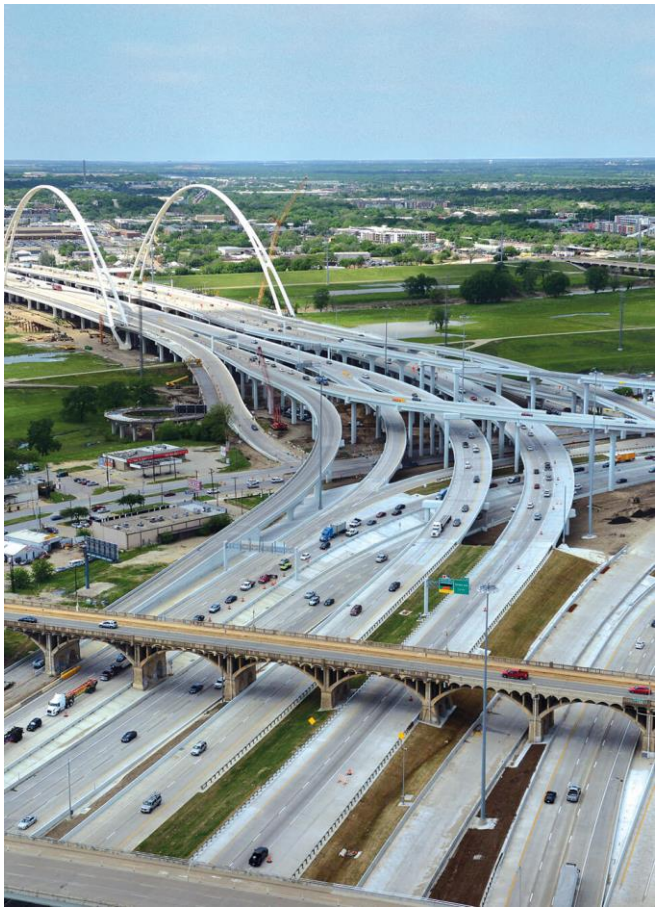
Consider these benefits of design/build projects

"It's no secret that engineers are often reluctant to use or be involved in design/build projects," but the Dallas Horseshoe interchange proved their worth, its principal engineer says. Robert Brown, P.E., M.ASCE, WSP USA vice president and Dallas-area transportation manager, shared the advantages of such projects with ASCE's *Civil Engineering* magazine.

Lucky Horseshoe

Robert Brown, P.E., M.ASCE

A $798-million Dallas highway project improved traffic flow into and out of the city's downtown. The new "Horseshoe" interchange corrected the traffic bottlenecks and safety concerns of the original design from the 1960s with improved geometry, wider bridges, and relocated exits.



Raised in Dallas, the author--Robert M. Brown, P.E., M.ASCE--had firsthand experience driving through the old Mixmaster interchange. He helped lead the design of the new "Horseshoe" interchange that replaced the Mixmaster.

GROWING UP IN DALLAS in the 1960s, I often rode with my parents through an amazing downtown highway interchange known as the Mixmaster. I marveled at its pristine, space-age design as we navigated its intricate maze of onramps and left-turn exits that connected Interstate 30 and Interstate 35 East and crossed Dallas's Trinity River. Gradually, though, the luster of this once magnificent interchange faded. What was state of the art when it opened in the 1960s eventually developed an unfortunate reputation as a site of frustrating bottlenecks, lengthy traffic delays, and safety concerns.

The original intersection was deteriorating and ill-equipped to handle the estimated 450,000 to 500,000 vehicles that passed through it on a normal weekday. The bridges that crossed the Trinity River had inadequate capacity, narrow lanes, and large sections of deteriorating structural components that frequently required emergency repairs. The unavoidable truth was that the Mixmaster of the 1960s, which accommodated roughly one-tenth of today's traffic volume, was in desperate need of more than just upgrades. It begged for a wholesale replacement.

Today, the Mixmaster is a distant memory. It has been completely replaced by the Dallas Horseshoe, a $798-million interchange that has substantially improved the flow of traffic crossing the Trinity River along I-30 and I-35 East to get into or out of downtown Dallas.

Pegasus Link Constructors (PLC)—a joint venture of Fluor Corporation, of Irving, Texas, and London-based Balfour Beatty—had been awarded the design/build contract to deliver the Dallas Horseshoe on behalf of the Texas Department of Transportation (TxDOT). As lead designer to PLC, New York City-based WSP USA was responsible for designing the roadways, bridges, river crossings, retaining walls, drainage, geotechnical engineering, and maintenance of traffic plan. In my role as Dallas area manager, I led the bidding phase and served as principal-in-charge during the design phase.

Completed in the 1960s, the once state-of-the-art Mixmaster was eventually plagued by bottlenecks, traffic delays, and safety problems. TEXAS DEPARTMENT OF TRANSPORTATION.

Design of the Horseshoe began in 2013, and construction commenced in January 2014. The project was substantially completed on schedule in April 2017.

One of the greatest problems with the Mixmaster involved its confusing left-lane exits. Motorists are conditioned to bear right when preparing to exit a highway, so the left-lane exits on the Mixmaster felt unnatural, especially for drivers unfamiliar with the arrangement. As a result, the Mixmaster was notorious for its alarming frequency of overturned tractor trailers. No matter how many warnings were posted-or how many communication methods were attempted-trucks would flip on their sides after drivers realized too late that they were in the wrong lane and unsuccessfully weaved to the left, losing control of their vehicles and spilling over the roadway. These crashes would create traffic chaos for as much as 12 hours while crews cleared the highway, not to mention the potential danger to life and limb.

To further complicate matters, as the predominantly north-south I-35 approaches the Dallas-Fort Worth region, it splits as I-35 East goes through downtown Dallas and I-35 West goes through downtown Fort Worth. Traffic making its way between a southbound section of I-35 East and a westbound section of I-30 had to merge with traffic along Riverfront

Boulevard before completing that transition. For anyone unfamiliar with the complicated alignment-and even for those of us who were all too familiar with it-the Mixmaster could be a nightmare.

Naturally, correcting the odd geometry of the Mixmaster became one of our highest design priorities. The plan we developed for the Dallas Horseshoe eliminated all left exits, providing direct connections from northbound I-35 East to westbound I-30, and eastbound I-30 to southbound I-35 East. Under the new design, the different lanes of traffic no longer merge, and both I-30 and I-35 East have their own parallel freeway segments. Additionally, I-30 at the Trinity River was expanded from 6 lanes to 17, while I-35 East at the river increased from 9 to 18 lanes.

Dallas Horseshoe Improvements. TEXAS DEPARTMENT OF TRANSPORTATION.

As a result, today there is less weaving, less congestion, and the roadway is much safer for motorists.

TxDOT required that traffic continue to flow through the interchange at all times throughout construction-without using detours that could clog secondary roads. That meant we were not only removing and replacing every square inch of road, every bridge, and every wall, but doing it while we kept traffic moving and motorists safe.

The design/build contract incorporated several incentives, including a lane rental specification. It meant that if at any point we made the decision to close freeway lanes, we had to pay TxDOT for the right to do so. The longer we closed the lanes, the more we had to pay, and if we closed lanes during daytime or peak traffic hours, we had to pay even more. Clearly, that meant that it was in everyone's best interests to keep lane closures to a minimum. Considering that the Dallas Horseshoe included the construction of more than 73 lane miles of new roadway, 37 conventional bridges and more than 60 retaining walls, this was no small task.

One way we met the challenge was by building the new roadways from the outside lanes inward. This allowed motorists to continue using the old lanes until the new ones were completely ready for traffic. The traffic then transitioned to the outer lanes so that work on the inside lanes could begin.

Another challenge with the Mixmaster was the fact that the interchange also passed underneath the Houston Street Viaduct, a repeating concrete arch structure and historic landmark built in 1911 and added to the National Park Services' National Register of Historic Places in 1984. All lanes, ramps, and roads had to pass over or under this bridge with no impact. As construction progressed, WSP and PLC developed more than 70 geometric refinements to the plan, such as shifting phased construction out of the way of existing traffic. The team also kept lane closures to a minimum and worked to lower costs for the contractor.

WSP's geotechnical engineering responsibilities for the project included pavement design; bridge foundation design consisting of reinforced-concrete drilled shafts; and ground improvement and global stability analysis for the retaining walls. Special shoring was also required in constrained areas. The entire storm drain system was also removed and replaced because of increased runoff from development and to achieve the client's desired design criteria.

The design of the new Dallas Horseshoe interchange eliminated all left-lane exits, resulting in less weaving, less congestion, and a much safer roadway. COURTESY OF PLC.

Retaining walls were installed throughout the Horseshoe work site, but locations were often limited by the constrained right-of-way within the construction area. The project used mechanically stabilized earth retaining walls, which were typically 5 to 25 ft in height. The mechanically stabilized earth wall foundations used a leveling pad along with granular backfill and reinforcing grids to complete the design.

The Horseshoe was constructed on some of the most challenging soil and rock conditions in North Texas. The site featured largely alluvial soils deposited by the Trinity River and not high in strength or stability.

Rather than rely on empirical data and standard charts and graphs, the geotechnical team performed full-scale load testing to develop the foundation design. This work included test shafts with load cell devices and a full array of displacement and stress monitoring devices to develop site-specific load-displacement curves. The geotechnical team used these curves to optimize bridge and wall foundations, which promoted greater overall project economy and value.

I'M OFTEN ASKEd how the Horseshoe got its name. The origin is quite simple: it refers to the U shape of the project, which resembles a horseshoe in plan. Indeed, the concept of "simple" is a recurring theme for this project. Our goal was to simplify travel for motorists. However, to reach that point required complex planning and constant coordination between the designers and builders. It's not always easy to make things easy.

With such a large scope of work and an aggressive schedule, efficient communication was essential to the success of the Horseshoe project. To facilitate open communication and expedited decisions, a technical working group leader was appointed from the design team, construction team, and TxDOT; there was one for each discipline. These leaders were

experienced and able to make critical decisions that were instrumental in maintaining the aggressive design schedule.

Substantially completed on schedule in April 2017, the $798-million Dallas Horseshoe project has received several awards for its design and the improvements it made to transportation in the region. COURTESY OF PLC.

We were constantly assessing the progress of the project and providing ideas to improve traffic flow while keeping construction on track. One example was our use of "active traffic management" techniques. For more than 50 years, traffic on the Mixmaster exited to the left. But midway through construction, motorists familiar with the way things had been done on the Mixmaster suddenly had to be retrained to find their exits on the right. After the lanes began to take shape, it was determined that we needed this message about the new exit design to stand out so that drivers would take notice. The answer was the installation of eight bright, eye-catching digital lane-use signs over each lane, which helped drivers easily identify the correct lane to take to reach the new exit locations. It proved an effective solution to the problem.

At other times, an idea that had not worked early in the design process suddenly became more viable as the project progressed. This came into play while accommodating TxDOT's technical requirement to keep the ramps and other access points open throughout construction. Early in the design process, we had been convinced that the use of temporary detour pavement and even temporary bridges would be necessary to maintain these movements. But by having the design and construction teams work together, a phasing plan was created and plotted to eliminate all temporary bridges and reduce detour pavement requirements.

Cooperation during the bidding phase in modifying the roadway's horizontal and vertical design, phase order, construction timing, and construction needs streamlined the maintenance-of-traffic plan early and helped us identify critical construction constraints. It was essential to anticipate changes to the maintenance-of-traffic plan because different sections would need to be completed at different rates, which meant that delays in one section could impact the progress of other areas. This was especially critical because of certain changes in traffic that were contingent on other changes happening first.

Open communication between the designers and contractors helped determine the level of plan modification needed without overworking a simple change. It helped to determine the scope of any changes so that the designers would not corner the contractor with plan revisions; likewise, we worked to ensure that a contractor's request would not require an unanticipated reconstruction or additional temporary work later. At the same time, the ability to adjust the design was critical to the Horseshoe's success, especially when we could combine multiple operations within the same phase to limit lane closures. This proved to be most effective when we were able to conduct bridge work, overhead sign work, and pavement and striping work all in the same location.

Rebecca Fly, A.M.ASCE, a WSP project manager, met with stakeholders early and often to learn and understand the project scope and to facilitate those adjustments. This allowed the WSP team to deliver high-quality drawings and provide effective project management. During the construction phase, the engineers fast-tracked production by deploying multiple design teams, all working simultaneously from as many as eight WSP office locations.

Bringing the discipline design leaders, construction field engineers, superintendents, and TxDOT officials into one collaborative group not only optimized innovations, it also expedited constructability and owner reviews of the design packages because the reviewers were already familiar with the design. The open communication process was further enhanced by increasing the amount of face-to-face interaction and by colocating the PLC construction team and the TxDOT representatives.

One of the key principles of continuous improvement is to listen to the labor force and value its input. The Dallas Horseshoe is a testament to what can be achieved with that thought in mind, as well as the realization that innovative ideas don't come exclusively from the engineers. For instance, we received many great suggestions from the construction crews who were out on the project site and could see where improvements might be possible. In particular, the field personnel were able to visualize ways to reduce utility conflicts and provide ideas for detouring traffic.

As a result, we employed recommendations from the field on numerous occasions. With open lines of communication, field personnel were encouraged to present their observations and thoughts to the designers. If it was an idea that had merit, it would be incorporated into the plan through a process that was often completed within two days. This became useful for many of the structural details on the project, such as the retaining walls and stormwater drains.

IT'S NO SECRET THAT ENGINEERS are often reluctant to use or be involved in design/build projects. However, my experience on this project showed me two important benefits of the design/build approach:

- *Improved quality.* The designer, contractor, and TxDOT officials worked together throughout the project to ensure there were no errors or quality issues. Any problems identified along the way were promptly corrected at the design team's expense-which gave us a very strong incentive to provide the highest quality possible.

- *Collaboration.* The working relationship between the designer, contractor, and TxDOT officials was outstanding. Everybody pitched in to make improvements, keep the project on schedule, and focus on quality.

WSP's engineers participated in weekly technical working group meetings attended by WSP discipline leads; the contractor, San Antonio-based Raba Kistner Consultants Inc., as the quality firm; and the owner's staff. Those meetings were split into disciplines—roadway, drainage, bridges, retaining walls, and traffic—with the focus on phased construction, facilitating construction progress, and keeping traffic moving. The teamwork was outstanding, and it became a critical component in the success of this project. In particular, our engineers learned a great deal about construction issues that contractors face—issues that engineers, myself included, sometimes overlook. Those considerations included finding space for construction equipment, providing access for material delivery, and creating safe working spaces for construction crews.

Another focus involved keeping the construction schedule on track, especially in moments of adversity. Throughout the project, the priorities for construction changed frequently, depending on the availability of the craft workers and work areas. But the focus always remained on obtaining the highest efficiency for construction. For instance, the Horseshoe project was constructed during an unusually wet cycle for Dallas—in fact, water reached the banks of the Trinity River three times during the life of the project, which limited the ability to complete bridge foundation work in the floodway. However, the flexibility provided by the design/build contract enabled us to reprioritize the work to keep the project on schedule.

The Horseshoe is located within one of the oldest sections of Dallas—a constrained area with numerous utilities. As a result, the project required the relocation of nearly 150 major utilities involving the natural gas, fiber-optic communications, electric power transmission, wastewater, and public water systems. Fortunately, TxDOT had, early on, relocated the site's electric transmission lines. But interfacing with the other utilities posed some unusual challenges.

For example, the city of Dallas had numerous wastewater and water lines in the area—some as large as 96 in. in diameter—that WSP tried to avoid relocating as much as possible. We achieved this in the design by following a protect-in-place concept for the wastewater trunk line.

Passing under the Horseshoe project were several large sanitary sewer pipes, some of which directed stormwater from downtown Dallas to the Trinity River. These pipes had been constructed in the 1930s and 1940s and were expected to need replacement due to age. But a detailed inspection and condition assessment program concluded that only a few systems needed immediate replacement and that six protected-in-place, no-touch sanitary sewer lines had decades of remaining service life.

Using a special structural cap design known as a trampoline, new pavements were installed above the sewer lines to straddle these fragile services. The caps consisted of two layers of a geogrid fabric sandwiched within a flexible base material. This system was layered over the sewer lines that cross the I-30 interchange diagonally and parallel the northbound frontage road. This system protected the sewer lines and saved thousands of dollars by obviating the need to replace the lines with new pipes.

In other situations, we did relocate certain utilities, and we constantly had to adjust the design to accommodate utility issues. But we understood that this was part of our scope of work, not a setback. When there was a utility conflict, we were prepared to respond and adjust our design. Using a vacuum-truck excavation process, our team was able to identify the precise horizontal and vertical locations of the underground utilities, which was a great help in mapping out the utilities to make accurate design adjustments to our original plan. The ability to obtain accurate and complete utility locations also allowed the design team to avoid utility conflicts and minimized the need for redesigns.

THE PUBLIC OFTEN HAS A less-than-favorable view of highway construction projects because of their inconvenience and often lengthy durations. So PLC and WSP worked to turn the design/build delivery method into a way to minimize overall disruption to the traveling public and reduce the intensity and time the public was inconvenienced.

One such example involved the bridge design on the eastern side of the project. Because of the tight curves and difficulty of locating bridge bents over and around the main lanes of the Mixmaster, the TxDOT concept plans initially called for the construction of several long bridge spans using steel plate girders. But PLC and WSP reworked the underlying roadway, inserting bents where there were conflicts with utilities. In other cases, the bents were reworked to simplify the traffic control phasing. This, along with other techniques—such as building decks wider than needed for roadway function—allowed us to convert the steel spans into precast, prestressed concrete girder spans. Concrete spliced girders were designed to comply with the requirement for a minimum of four 250 ft spans across the Trinity River basin between the river's levees.

With no steel fabrication needed, we reduced the girder lead time, which made it possible to open the bridge to traffic sooner than if it had been constructed with steel girders. Furthermore, the maintenance life-cycle costs were reduced, which will have a lasting benefit for TxDOT.

Concrete spliced girders for long-span bridges in North Texas are rare—there had been only two such installations before the Horseshoe project. In part, that's because such girders required advanced technology, techniques, and equipment to analyze, design, fabricate, and erect properly. But by successfully utilizing these girders on the Horseshoe project, we redefined current engineering thinking, especially for this region.

The Horseshoe project also includes a signature bridge designed by world-renowned architect and engineer Santiago Calatrava, Ph.D., who has offices in New York City and Zurich. Known as the Margaret McDermott Bridge and located on the northwestern part of the Horseshoe project, the twin structure features two distinct, decorative arches that rise 350 ft above the Trinity River. The 1,125 ft long bridge incorporates pedestrian and bicycle lanes on either side of the twin spans, connecting the crossing to the city's growing network of pedestrian trails. [At press time, the pedestrian and bicycle lanes had not yet opened.]

Calatrava was under contract to the city of Dallas; WSP was not involved in the design of the Margaret McDermott Bridge. But the success of the overall project depended upon a close working relationship with the Calatrava team to make sure our highway design was compatible with the bridge.

The Dallas Horseshoe project has been recognized with awards for its design and overall improvements to transportation in the region. The Design-Build Institute of America selected the project for a 2017 National Award of Merit in Transportation, and the American Council of Engineering Companies (ACEC) of Texas named the Dallas Horseshoe the winner of the 2018 Engineering Excellence Award gold medal for transportation and was named the Eminent Conceptor awardee, representing the top engineering project in Texas. The project also received the Honor Award at the 2018 ACEC National Engineering Excellence Awards Gala on April 17. These awards reflect the positive feedback we have been hearing from TxDOT and Dallas city officials. In addition to those accolades, we have been getting comments from motorists who benefit from the improved interchange every day.

Nearly every motorist traveling through Dallas uses this interchange, and many people pass through it several times a day. Today those drivers are experiencing significantly faster travel times. Moreover, the Horseshoe not only relieves Dallas traffic congestion, it does so with infrastructure that is both aesthetically pleasing and cost-effective. Personally, to have had the opportunity to be a part of that effort from the beginning, and to see the benefits that it is creating, has been quite rewarding.

PROJECT CREDITS

Client Texas Department of Transportation **Design/build contractor** Pegasus Link Constructors, a joint venture of Fluor Corporation, Irving, Texas, and Balfour Beatty, London **Lead designer** WSP USA, New York City and other offices

Quality consultant Raba Kistner Consultants Inc., San Antonio

Robert M. Brown, P.E., M.ASCE, is a vice president and Dallas area transportation manager for WSP USA. He served as WSP's principal-in-charge on the Dallas Horseshoe project.

(Civil Engineering, 09.05.2018, http://www.asce.org/cemagazine/first-person--lucky-horse-shoe)

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

micro to MACRO - Mathematical Modelling in Soil Mechanics, May 29 - June 1, 2018, Reggio Calabria, Italy, www.microto-macro2018.unirc.it

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

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

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

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

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

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

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

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

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

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

Geotechnical Construction of Civil Engineering & Transport Structures of the Asian-Pacific Region, 4 ÷ 7 July, 2018,

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

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

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

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

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

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

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

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

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

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

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

International Conference on Geotechnical Engineering and Architecture URBAN PLANNING BELOW THE GROUND LEVEL: ARCHITECTURE AND GEOTECHNICS, 19-21 September 2018, Saint Petersburg, Russia, http://tc207ssi.org

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

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

GEC - Global Engineering Congress Turning Knowledge into Action, 22 - 26 October 2018, London, United Kingdom, www.ice.org.uk/events/global-engineering-congress

ISEV 2018 CHANGSHA The 8th International Symposium on Environmental Vibration and Transportation Geodynamics & the 2nd Young Transportation Geotechnics Engineers Meeting, October 26–28, 2018, Changsha, China, www.isev2018.cn

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

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

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

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

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

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

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

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

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

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

Contact person:

Professor Clarence Choi
Hong Kong University of Science and Technology, Clear Way Bay, Kowloon
Email: ceclarence@ust.hk

13th Australia New Zealand Conference On Geomechanics 2019
01 ÷ 03-04-2019, Perth, Australia
http://geomechanics2019.com.au

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

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

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

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

Conference Managers

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

www.eurogeo7.org

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

Contact: eurogeo7inpoland@gmail.com

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

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

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

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

Σεισμοί από έκλυση φυσικού αερίου

Γεωεπιστήμονες έχουν στρέψει το βλέμμα τους στην επίδραση των σεισμικών δονήσεων στα κοιτάσματα φυσικού αερίου.

Σεισμούς που δεν προκαλούνται από τη μετακίνηση των τεκτονικών πλακών αλλά από την έκλυση φυσικού αερίου στο υπέδαφος ανίχνευσαν Γάλλοι, Γερμανοί και Τούρκοι γεωεπιστήμονες, οι οποίοι μελετούν την περιοχή Κωνσταντινούπολης - Μαρμαρά.

Οι ερευνητές, με επικεφαλής τον Λουί Ζελί του Γαλλικού Κέντρου Ερευνών Ifremer και τον Μάρκο Μπόνχοφ του Γερμανικού Ερευνητικού Κέντρου Γεωεπιστημών GFZ του Πότσνταμ, που έκαναν τη σχετική δημοσίευση στο περιοδικό Scientific Reports, ανέλυσαν σεισμικά δεδομένα από τη Θάλασσα του Μαρμαρά.

Διαπίστωσαν ότι, ύστερα από έναν σεισμό ακόμη και 5,1 βαθμών, είναι δυνατό να διαταραχθεί ένα γειτονικό κοίτασμα φυσικού αερίου, με αποτέλεσμα να «δραπετεύσει» το αέριο, να κινηθεί προς τα πάνω και να προκαλέσει με τη σειρά του νέους πιο ασθενείς μετασεισμούς. Η μητροπολιτική περιοχή της Κωνσταντινούπολης, όπου ζουν περίπου 15 εκατομμύρια άνθρωποι, είναι ιδιαιτέρως σεισμογενής. Οι ξένοι επιστήμονες εκτιμούν ότι υπάρχει πιθανότητα 35% έως 70% να γίνει εκεί ένας σεισμός άνω των 7 βαθμών έως το 2040. Οι ερευνητές επεσήμαναν ότι οι σεισμοί που προκαλούνται από τα αέρια συμβαίνουν συνήθως σε πολύ μικρά βάθη κάτω από τον βυθό. Ο ακριβής μηχανισμός τους δεν είναι ακόμη σαφής. Σύμφωνα με τους επιστήμονες, μπορεί το μετακινούμενο φυσικό αέριο να ενεργοποιεί προϋπάρχοντα μικρά ρήγματα ή να προκαλεί ταλαντώσεις σε υπόγειες κοιλότητες γεμάτες με νερό. Όπως είπε ο Μπόνχοφ, τα νέα ευρήματα για τον ρόλο του φυσικού αερίου «δεν μεταβάλλουν κατ' ανάγκην τον σεισμικό κίνδυνο για την περιοχή της Κωνσταντινούπολης, όμως πρέπει πλέον να ληφθούν υπόψη στα διάφορα σενάρια μελλοντικών σεισμών, ώστε αυτά να γίνουν πιο ρεαλιστικά. Σε αυτό το πλαίσιο, θα πρέπει επίσης να επισημάνουμε μια παράμετρο που έως τώρα έχει περάσει τελείως απαρατήρητη από το κοινό, ότι η γειτνίαση του Ρήγματος της Βόρειας Ανατολίας και των κοιτασμάτων του αερίου συνιστά πρόσθετο σεισμικό κίνδυνο».

Ο Γερμανός γεωφυσικός προσέθεσε ότι, επειδή μεγάλες δεξαμενές φυσικού αερίου έχουν κατασκευαστεί στην ξηρά κοντά στο ρήγμα, υπάρχει αυξημένος κίνδυνος, σε περίπτωση ισχυρού σεισμού, να προκληθεί διαρροή ή και έκρηξη του αερίου. «Κάτι τέτοιο αυξάνει τον κίνδυνο καταστροφών για τον πληθυσμό ύστερα από ένα σεισμό», προειδοποίησε.

http://www.kathimerini.gr/962191/article/epikairothta/perivallon/seismoi-apo-eklysh-fysikoy-aerioy

Gas and seismicity within the Istanbul seismic gap

L. Géli, P. Henry, C. Grall, J.-B. Tary, A. Lomax, E. Batsi, V. Riboulot, E. Cros, C. Gürbüz, S. E. Işık, A. M. C. Sengör, X. Le Pichon, L. Ruffine, S. Dupré, Y. Thomas, D. Kalafat, G. Bayrakci, Q. Coutellier, T. Regnier, G. Westbrook, H. Saritas, G. Çifçi, M. N. Çağatay, M. S. Özeren, N. Görür, M. Tryon, M. Bohnhoff, L. Gasperini, F. Klingelhoefer, C. Scalabrin, J.-M. Augustin, D. Embriaco, G. Marinaro, F. Frugoni, S. Monna, G. Etiope, P. Favali & A. Bécel

Abstract

Understanding micro-seismicity is a critical question for earthquake hazard assessment. Since the devastating earthquakes of Izmit and Duzce in 1999, the seismicity along the submerged section of North Anatolian Fault within the Sea of Marmara (comprising the "Istanbul seismic gap") has been extensively studied in order to infer its mechanical behaviour (creeping vs locked). So far, the seismicity has been interpreted only in terms of being tectonic-driven, although the Main Marmara Fault (MMF) is known to strike across multiple hydrocarbon gas sources. Here, we show that a large number of the aftershocks that followed the M 5.1 earthquake of July, 25th 2011 in the western Sea of Marmara, occurred within a zone of gas overpressuring in the 1.5–5 km depth range, from where pressurized gas is expected to migrate along the MMF, up to the surface sediment layers. Hence, gas-related processes should also be considered for a complete interpretation of the micro-seismicity (~M < 3) within the Istanbul offshore domain.

Nature.com / Scientific Reports, **Volume 8**, Article number: 6819(2018), doi:10.1038/s41598-018-23536-7,
https://www.nature.com/articles/s41598-018-23536-7

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Σαντορίνη: Μελέτη «ζωντανεύει» την αρχαία ηφαιστειακή νήσο Καμένη του 16ου αιώνα π.Χ.

Πριν από τη σημερινή νήσο Καμένη, μέσα στην καλντέρα της Σαντορίνης, που δημιουργήθηκε μετά την έκρηξη του ηφαιστείου πριν από περίπου 3.600 χρόνια, υπήρχε μια πολύ παλαιότερη Καμένη, στο ίδιο περίπου σημείο, η οποία καταστράφηκε ολοσχερώς από την έκρηξη.

Για πρώτη φορά ξένοι και Έλληνες επιστήμονες, οι οποίοι μελέτησαν τα υποθαλάσσια απομεινάρια στο βυθό από εκείνη τη μινωική έκρηξη, καθώς και τα κομμάτια ανδεσιτικής λάβας μέσα στην ελαφρόπετρα, προχώρησαν στην ανασύσταση της λεγόμενης προ-Καμένης, καταλήγοντας σε εκτιμήσεις για την έκτασή της, τον τρόπο της δημιουργίας της και την ηλικία της.

Πριν από περίπου 22.000 χρόνια είχε προηγηθεί μια άλλη μεγάλη έκρηξη στη Θήρα, η λεγόμενη έκρηξη της Ρίβας, από την οποία είχε δημιουργηθεί μια μεγάλη ημίκλειστη καλντέρα.

Μέσα σε αυτήν σταδιακά ανυψώθηκε ένα νησί, η προ-Καμένη, που έμελλε να καταστραφεί, μαζί με τμήματα της Θήρας και της Θηρασίας, κατά την πιο πρόσφατη μινωική έκρηξη κατά την Ύστερη Εποχή του Χαλκού.

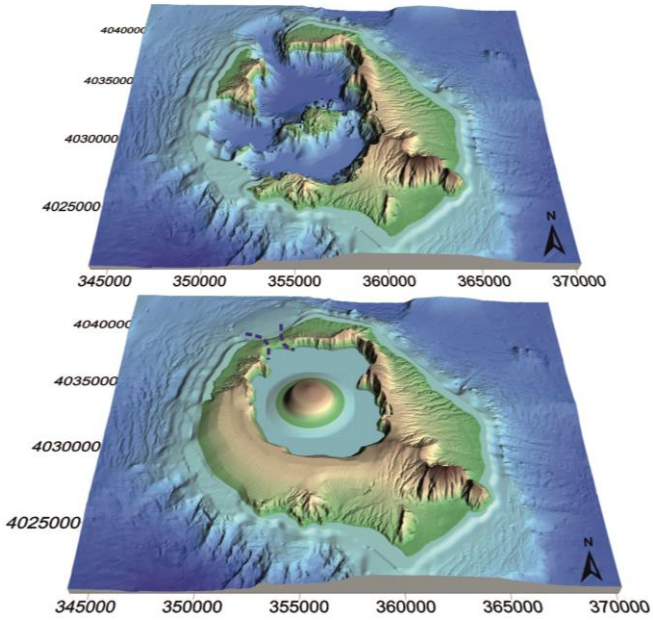
Οι ερευνητές, με επικεφαλής τον Ούγγρο γεωεπιστήμονα Ντέιβιντ Κάρατσον του Τμήματος Φυσικής Γεωγραφίας του Πανεπιστημίου Eotvos της Βουδαπέστης, που έκαναν τη σχετική δημοσίευση στο περιοδικό «Scientific Reports» του Nature Group, χρησιμοποίησαν φωτοστατιστική ανάλυση, κοκκομετρία και άλλες τεχνικές για να υπολογίσουν ότι η προ-Καμένη είχε όγκο 2,2 έως 2,5 κυβικών χιλιομέτρων, έναντι 3,2 κυβικών χιλιομέτρων της σημερινής Παλαιάς και Νέας Καμένης.

Όπως δήλωσε στο ΑΠΕ-ΜΠΕ ο Ντ. Κάρατσον:

«Το τοπογραφικό ανάγλυφο της Σαντορίνης πριν από την μινωική έκρηξη χαρακτηριζόταν από ένα μικρότερο λιμάνι μαζί με ένα κεντρικό νησί, περίπου παρόμοιο με τη σημερινή Καμένη, σύμφωνα με πολλούς ερευνητές. Όμως οι διαστάσεις και η ηλικία αυτού του νησιού είχαν παραμείνει άγνωστες. Στη νέα μελέτη μας, ανακατασκευάσαμε το προ-μινωικό νησί με την ονομασία Προ-Καμένη τόσο σε μέγεθος όσο και σε ηλικία.

Εστιάσαμε το ενδιαφέρον μας στα πιο χαρακτηριστικά λιθικά ανδεσιτικά δείγματα που βρίσκονται μέσα στη μινωική ελαφρόπετρα, που αντιπροσωπεύουν το εκρηκτικό υλικό από την Προ-Καμένη. Εφαρμόζοντας μια φωτο-στατιστική ανάλυση, υπολογίσαμε τον όγκο της Προ-Καμένης σε 2,2 έως 2,5 κυβικά χιλιόμετρα, που είναι μικρότερος από τον όγκο της Παλαιάς και της Νέας Καμένης.

Προσδιορίσαμε επίσης την ηλικία των ανδεσιτικών κομματιών της λάβας, με τη μέθοδο Cassignol-Gillot K-Ar, σε 20.000 χρόνια πριν από σήμερα, κάτι που σημαίνει ότι η προ-Καμένη άρχισε να αναπτύσσεται πολύ σύντομα μετά την προηγούμενη μεγάλη έκρηξη της Ρίβας πριν από 22.000 χρόνια».



Ψηφιακή τοπογραφική ανακατασκευή της προμινωικής καλδέρας (κάτω) και της προ-Καμένης σε σχέση με τη σημερινή εικόνα (πάνω)

Σύμφωνα με τη νέα μελέτη, μετά την ισχυρή έκρηξη Ρίβα που είχε προηγηθεί της μινωικής, στο προμινωικό τοπίο της Σαντορίνης κυριαρχούσε μια ρηχή πλημμυρισμένη καλδέρα, όπου σιγά-σιγά, καθώς εξέρρεε λάβα από το υποθαλάσσιο ηφαίστειο, άρχισε να ξεμυτίζει η προ-Καμένη.

Μέχρι σήμερα μόνο πολύ αβέβαιες εκτιμήσεις μπορούσαν να γίνουν για το μέγεθος και την ηλικία της.

Η επίκουρη καθηγήτρια Παρασκευή Νομικού του Τμήματος Γεωλογίας και Γεωπεριβάλλοντος του Πανεπιστημίου Αθηνών, η οποία συμμετείχε στη μελέτη, δήλωσε στο ΑΠΕ-ΜΠΕ ότι:

«Η προμινωική καλδέρα ήταν μικρότερη από τη σημερινή, κλειστή στα νοτιοδυτικά και με ένα μόνο μικρό άνοιγμα στα βορειοδυτικά με ένα στενό κανάλι.

Στο κέντρο της ρηχής πλημμυρισμένης καλδέρας υπήρχε η μικρότερη από τη σημερινή προ-Καμένη με ένα χαμηλό ηφαιστειακό κώνο».

Η προ-Καμένη αναπτύχθηκε πολύ γρήγορα μετά την έκρηξη Ρίβα, με ένα ελάχιστο ρυθμό εκροής λάβας 0,13 έως 0,14 κυβικών χιλιομέτρων ανά χιλιετία. Ο ρυθμός αυτός είναι πολύ πιο αργός -περίπου το ένα έβδομο- από τον μέσο ρυθμό διόγκωσης της σημερινής Παλαιάς και Νέας Καμένης μετά το 1600 π.Χ., ο οποίος εκτιμάται σε περίπου 0,9 κυβικά χιλιόμετρα ανά χιλιετία.

Η έκρηξη της Θήρας μεταξύ 1627-1600 π.Χ. κατά την Ύστερη Εποχή του Χαλκού (Μινωϊκή) υπήρξε μια από τις μεγαλύτερες στη διάρκεια της Ολοκαίνου. Τα προϊόντα της έκρηξης εκτιμάται ότι είχαν όγκο 117 έως 129 κυβικά χιλιόμετρα, ισοδύναμα με 78 έως 86 κυβικά χιλιόμετρα πυκνών πετρωμάτων.

Ένα μέρος αυτών των πυροκλαστικών εναποθέσεων στο βυθό της Σαντορίνης προέρχεται από την προϋπάρχουσα Καμένη, η οποία διαλύθηκε τελείως από την έκρηξη. Η σύνθεσή της από μαύρο υαλώδη ανδεσίτη, που είναι γεωχημικά διακριτός, επέτρεψε στους επιστήμονες να ξεχωρίσουν ποια προϊόντα της έκρηξης προέρχονταν από την προ-Καμένη και ποια από τη Θήρα.

Στη μελέτη επίσης συμμετείχαν γεωεπιστήμονες από τη Βρετανία, τη Γαλλία και τη Νέα Ζηλανδία.

(CNN Greece, Παρασκευή, 04 Maiou 2018, http://www.cnn.gr/news/ellada/story/128552/santorini-meleti-zontaneyei-tin-arxaia-ifaisteiaki-niso-kameni)

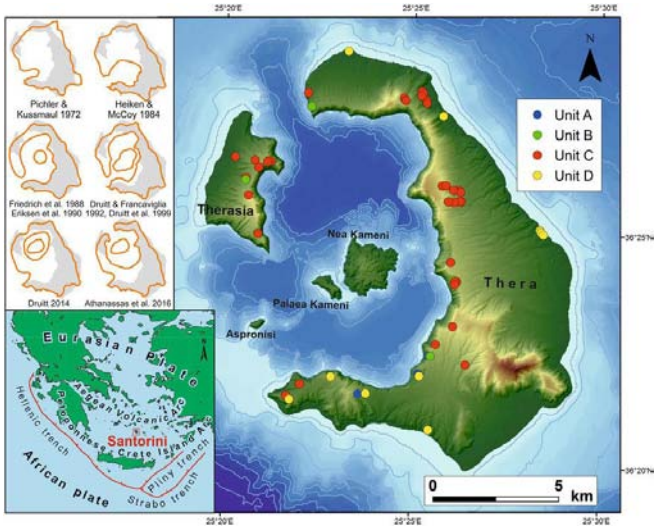
(Η ΚΑΘΗΜΕΡΙΝΗ, 04.05.2018, http://www.kathimerini.gr/962495/article/epikairothta/episthmh/etsi-htan-h-santorinh-ton-16o-aiwna-px-prin-thn-minwikh-ekrh3h)

Towards reconstruction of the lost Late Bronze Age intra-caldera island of Santorini, Greece

Dávid Karátson, Ralf Gertisser, Tamás Telbisz, Viktor Vereb, Xavier Quidelleur, Timothy Druitt, Paraskevi Nomikou & Szabolcs Kósik

Abstract

During the Late Bronze Age, the island of Santorini had a semi-closed caldera harbour inherited from the 22 ka Cape Riva Plinian eruption, and a central island referred to as 'Pre-Kameni' after the present-day Kameni Islands. Here, the size and age of the intracaldera island prior to the Late Bronze Age (Minoan) eruption are constrained using a photo-statistical method, complemented by granulometry and high-precision K-Ar dating. Furthermore, the topography of Late Bronze Age Santorini is reconstructed by creating a new digital elevation model (DEM). Pre-Kameni and other parts of Santorini were destroyed during the 3.6 ka Minoan eruption, and their fragments were incorporated as lithic clasts in the Minoan pyroclastic deposits. Photo-statistical analysis and granulometry of these lithics, differentiated by lithology, constrain the volume of Pre-Kameni to 2.2–2.5 km^3. Applying the Cassignol-Gillot K-Ar dating technique to the most characteristic black glassy andesite lithics, we propose that the island started to grow at 20.2 ± 1.0 ka soon after the Cape Riva eruption. This implies a minimum long-term lava extrusion rate of ~0.13–0.14 km^3/ky during the growth of Pre-Kameni.



Santorini: tectonic setting and island map with photo-statistical sampling sites. Upper left inset shows the development of Santorini's pre-Minoan caldera models. Units A to D refer to the deposits of the four phases of the Minoan eruption.

Nature.com / Scientific Reports, **Volume 8**, Article number: 7026(2018), doi:10.1038/s41598-018-25301-2, https://www.nature.com/articles/s41598-018-25301-2

Nuclear Bomb Test Moved North Korea Mountain

This Digital Globe satellite image shows Punggye-ri, the North Korea nuclear test site.

North Korea conducted its latest nuclear test at Punggye-ri on Sept. 3, and it was the most massive one yet, registering on sensors as a 6.3-magnitude earthquake. Around 8 minutes later, geologists detected a smaller rumbling of 4.1 magnitude that got scientists speculating: Could the nuclear test site, hidden inside a mountain, have collapsed?

A massive collapse could render the test site useless for future nuclear tests and may even increase the risk of radioactive gases escaping from the rock and into the air, scientists said.

The case for this so-called "tired mountain syndrome" was bolstered three weeks ago, when North Korea announced

that it planned to shut the main testing facility at Mount Mantap where five of the six tests, including the last explosion, took place. A few weeks ago, a group of Chinese geologists claimed in a study published in Geophysical Research Letters that the mountain had collapsed following the latest nuclear test.

Now, scientists reporting today (May 10) in the journal Science have used satellite images to find that Mount Mantap indeed moved and compressed following the explosion. But according to the scientists, the mountain and test sites probably didn't collapse completely.

Previously, scientists have gauged nuclear explosions by the ground shaking the blasts produced, using seismic data similar to how earthquakes are measured. But in this new study, the team analyzed satellite images taken by the German TerraSar-X satellite and Japan's ALOS-2 satellites, and compared the landscape of Mount Mantap before and after the explosion. These satellites use what's called a synthetic aperture radar, which beams electromagnetic waves down to Earth and then measures the reflected light, according to the National Oceanic and Atmospheric Administration. By doing so, the technology can create high-resolution images even under suboptimal conditions of bad weather (because microwaves can penetrate clouds) and low light.

Using these images, the team found that Mount Mantap moved by around 11.5 feet (3.5 meters) and shrank by 1.6 feet (0.5 m). This may indicate a collapse of tunnels in the mountain according to Teng Wang, senior research fellow at the Earth Observatory of Singapore in the Nanyang Technological University and the first author of the paper.

"But we could not tell if this is the [complete] collapse of the whole test site or the collapse of the tunnel, as there is no direct evidence for it," Wang said. People would need to investigate on-site to figure that out, he added.

The team also analyzed seismic data and found that the direction the waves traveled was exactly the opposite of the actual explosion. So, since the explosion would have been outward, the second 4.1-magnitude rumbling might have been inward, indicating a collapse as the previous study did.

But the ground shaking could have resulted from the collapse of a void in the rocks that was created by a previous explosion or even the most recent explosion, said Douglas Dreger, an Earth and planetary science professor at the University of California, Berkeley, and co-author of the paper. Or, he added, it could have been a tunnel, a partial tunnel, or a multiple tunnels.

"I wouldn't say that the whole mountain collapsed, I wouldn't draw the catastrophic conclusion," Dreger said.

The researchers estimated that the strength of the explosion was about 120 to 304 kilotons, or 10 times that dropped on Hiroshima, according to a statement. (Other estimates differ, with one saying it was as strong as 17 times that of Hiroshima, according to The Washington Post).

Wang hopes this study will push forward the use of satellite imaging to research underground nuclear tests.

(Yasemin Saplakoglu, Staff Writer / LIVE SCIENCE, May 10, 2018 04, https://www.livescience.com/62534-north-korea-nuclear-test-moved-mountain.html?utm_source=ls-news-letter&utm_medium=email&utm_campaign=20180511-ls)

Over 300 homes destroyed after big cracks appear in Uganda

Large cracks open up in Uganda following heavy rains.

Over 300 homes have been destroyed after several big cracks opened in Uganda's Namisinfwa district over the past couple of days.

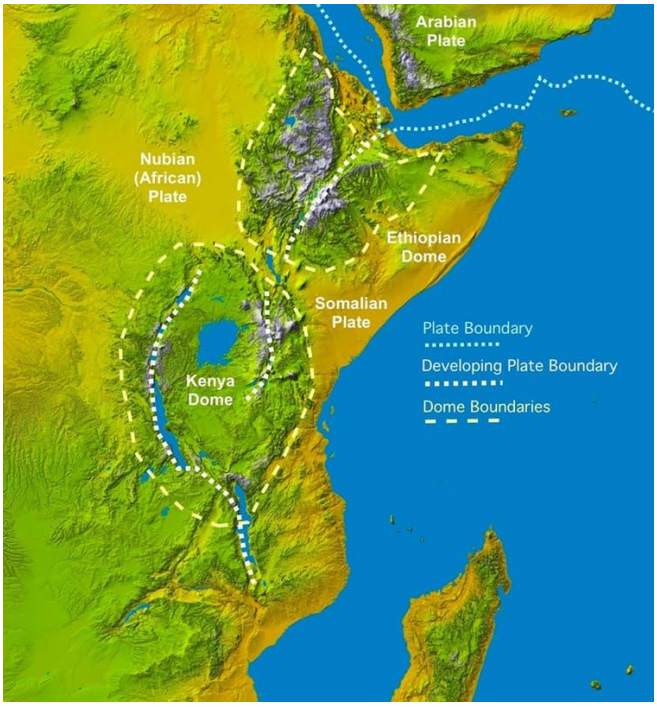
According to NTV Uganda, the cracks developed in Bupoto Sub County and Namisindwa town following heavy rain in the region.

They go right through people's houses, gardens and bridges, local authorities said, adding that water is coming out of some of the cracks, causing a lot of erosion and cracks in houses.

Dozens of people have been evacuated.

MPs have not been of help but if they heard there were dead people, they would hurry up to help, one of the locals said.

The events follow similar cracks in neighboring Kenya over the past two months. However, at this time they are nowhere near as large as those in Kenya.



Topography of the Rift Valley. Credit: James Wood and Alex Guth, Michigan Technological University. Basemap: Space Shuttle radar topography image by NASA

Both countries sit on East African Rift, an active continental rift zone in East Africa which consists of two main branches. The Eastern Rift Valley (also known as Gregory Rift) includes the Main Ethiopian Rift, running eastward from the Afar Triple Junction, which continues south as the Kenyan Rift Valley. The Western Rift Valley includes the Albertine Rift, and farther south, the valley of Lake Malawi. To the north of the

Afar Triple Junction, the rift follows one of two paths: west to the Red Sea Rift or east to the Aden Ridge in the Gulf of Aden.

The rift represents a narrow zone where the African Plate is in the process of splitting into two tectonic plates, called the Somali Plate and the Nubian Plate, at a rate of 6 - 7 mm (0.24 - 0.28 inches) annually.

(THE WATCHERS, May 24, 2018, https://watchers.news/2018/05/24/over-300-homes-destroyed-after-big-cracks-appear-in-uganda)

Over 300 homes have been destroyed after several big cracks opened in Uganda's Namisinfwa district during the same week.

The cracks developed in Bupoto Sub County and Namisindwa town following heavy rain in the region.

The events follow similar cracks in neighboring Kenya over the past two months.

(THE WATCHERS, May 31, 2018, https://watchers.news/2018/05/31/10-km-long-earth-crack-opens-on-elgeyo-escarpment-kenya/)

10-km-long earth crack opens on Elgeyo escarpment, Kenya

A 10-km-long (6.2 miles) earth crack has emerged on the slopes of Elgeyo escarpment in western Kenya last week, following heavy rain in the region. There are more than 10 000 households living on the escarpment, a part of the western wall of the Great Rift Valley. Locals are voluntarily evacuating the area.

The crack appeared on Thursday, May 24, 2018 and is just the latest in a series of similar events in Kenya and neighboring Uganda in which hundreds of homes have been damaged or destroyed.

The fissures that stretch more than ten kilometers have cut through Kapsegut, Ketigoi and Kalwal villages and residents are living in fear that the area might sink. Roads linking the villages to other areas have been rendered impassable, Kenya's The Standard reports.

The water has been oozing to the surface, causing depression in the earth and raising fears of landslides, locals told the paper.

Geologist Henry Kurgat warned that the fissures were a ticking time bomb.

"Given the extent of the cracks, emergency measures must be taken. Those who live downstream should be moved immediately because if the rains continue, it will take less than three days for the lower layer of the soil to roll down," he said.

Elgeyo Escarpment

Elgeyo escarpment is a fault-scarp caused by post-Miocene faulting and there are Miocene beds visible. The escarpment is part of the western wall of the Great Rift Valley. [1]

The northwest part of Kenya has three main geographic zones running in parallel north to south. There is the highland plateau, which rises gradually to 3,350 meters above sea level, on the Cherangani Hills. In the intermediate zone is the Elgeyo Escarpment which rapidly gives way to the lower Kerio Valley. The yearly rainfall in the escarpment area ranges between 100–140 cm.[2]

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1. *Shacleton, Robert Millner (1950). "A contribution to the geology of the Kavirondon Rift Valley". Quarterly Journal of the Geological Society. **106**: 345. doi:10.1144/GSL.JGS.1950.106.01-04.18.*

2. *Julius Muchemi, Wangu Mwangi & Heinz Greijn. "GIS in support of participatory land use planning in the Districts Keiyo & Marakwet, Kenya". www.gisdevelopment.net. Retrieved 2008-03-16.*

(From Wikipedia, the free encyclopedia, https://en.wikipedia.org/wiki/Elgeyo_Escarpment)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

19 Mechanical Engineering Innovations That Helped Define Mechanics Today

The discipline of mechanical engineering is a very wide and deep one ranging from the smallest component to the complexity of a modern engine.

Mechanical engineering is a very wide discipline that, effectively, covers anything that moves. Its breadth is due, in part, from its need to cover the design and manufacture of anything and everything in a moving system.

This ranges from a system's smallest components to the completed, sometimes enormous, machine as a whole. Throughout history some innovations have come to define mechanics as we know it today, the following are no exception.

These engineering innovations range from the any one of the classical 'simple machine' to complex concepts such as flight. This list is far from exhaustive and in no particular order.

1. The Aeolipile Was an Early Steam Reaction Turbine

The Aeolipile was the world's first rotating steam engine or more technically correct, a steam reaction turbine. It was devised by the great Heron of Alexandria in the **1st Century AD** and described it in great detail in his book *Pneumatica*.

This relatively simple device works by heating a reservoir of water within the device to generating steam. The steam is then conducted through one of the copper supports to a pivoted brass sphere.

Once the steam reaches the sphere it escapes through one of two nozzles at the ends of two, small, opposingly pointing arms. The escaping steam generates thrust and causes the sphere to rotate.

The basic principle is simple but the device's real genius is its bearings. Only one of the supported arms pass steam to the sphere (via a sleeve bearing).

This pushes the sphere against the other supporting 'solid' arm that also has a thrust bearing. The solid arm comprises of a conical point that bears against a matching indentation on the surface of the sphere. This combination holds the sphere in place whilst it rotates.

2. Wheel and Axle - The Powerful Simple Machine

There are very few innovations in mechanical engineering that have had as much influence as the wheel. The modern world would look very different without them.

Wheels, technically the wheel and axle is one of the six simple machines as defined in antiquity and expanded during the Renaissance.

The first depictions of wheeled-vehicles appear on an earthenware *Bronocice* pot from Poland and dates to around **4000 BC**. The pot clearly depicts a wagon of some kind with four wheels set on two axles.

The earliest actual evidence of a physical wheel-axle combination comes from Slovenia and is dated to around **3360-3030 BC.**

Wheels literally changed the world and have been a constant feature of human transport devices the world over.

3. Windmills Began to Replace Manpower

Windmills are incredibly ingenious devices that are able to convert wind power into useful mechanical work. This is achieved by using large 'sails', usually made of wood, imparts rotational force to the main shaft that in turn can be used to power a process, like grinding flour.

The Persians were some of the first people to harness the

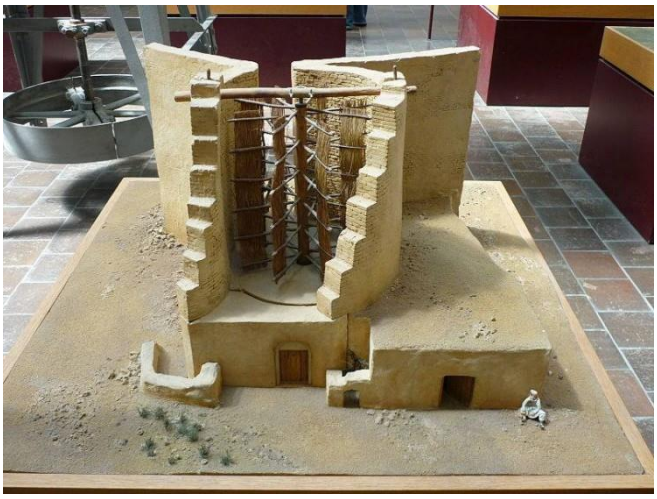
power of wind when they began building early forms of windmills in Iran and Afghanistan in around the **7th Century AD**.

These early windmills consisted of sails radiating from a vertical axis within a building with two large openings for the inlet and outlet of wind diametrically opposite each other. The mills were used to directly drive single pairs of millstones without the use of gears.

They were one of the first means by which civilizations were able to directly replace human beings as the main source of power for a process.

Windmills would become increasingly widespread throughout Europe during the Middle Ages and stayed in use well into the **19th Century.**

The development of steam power during the industrial revolution would spark the eventual decline of windmills.



Model of a 'Persian' vertical sail windmill.

4. Pulleys Make Lifting Things Easy

Pulleys are one, or several wheels, on an axle or shaft that support the movement and a change of direction of a cable or belt (that is usually taut). They transfer power between the shaft and cable and provide an immense mechanical advantage for providing large forces ideal for lifting heavy objects.

Pulleys come in various types:-

- A fixed pulley has an axle mounted in bearings attached to a supporting structure

- Movable pulleys have axles mounted on movable blocks.

- Compound pulleys are a mixture of the above two. The perfect example is the block and tackle pulley system.

The pulley was identified by the great Heron of Alexandria as one of the six simple machines. Today pulleys are an integral part of many mechanical systems including fan belts, flag poles, and water wells.

5. Man's Obsession with Flight Shrunk the World

Long before the Wright Brothers were even born, man has been trying to take to the air. One such lesser-known flight pioneer was Brother Eilmer. Eilmer was a monk from Malmesbury Abbey, England when he made an early attempt at flying in **1010 AD**.

An account of the event can still be found in William of Malmesbury's book *Gesta Regum Anglorum*.

It is said that he was inspired by the legend of Icarus to build a basic glider and attempt to fly. His glider was built from a wooden frame and either linen or parchment.

He would later launch himself from about **18 meters** above ground level, glided **200 meters** and subsequently panicked and crashed, breaking both his legs.

He returned to the drawing board and planned his next flight only to halted by an embargo from his Abbot to stop any further attempts.

Brother Eilmer's desire to fly, and others that followed him, like the Ottoman Celebi to the great Leonardo da Vinci, would drive our understanding of flight and aerodynamics.

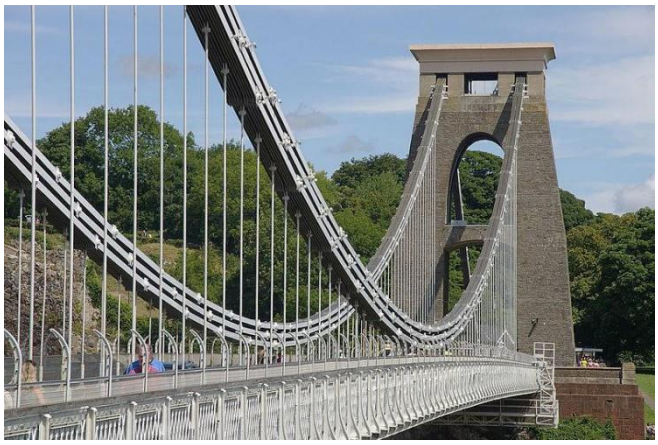
6. Steel was the Precursor to Many Later Mechanical Engineering Marvels

Steel has been known about since the beginning of the Iron Age. But for most of this time, the quality of iron produced varied widely.

The first blast furnaces began appearing in China in around the **6th Century BC** and would spread into Europe during the Middle Ages. By the **17th Century** iron was, more or less, well understood and by the **19th Century** production methods and quality were improved dramatically.

Early metallurgists realized that when iron gets very hot it begins to absorb carbon. This, in turn, reduces the melting point of iron as a whole and makes the final product brittle.

They soon realized that they needed to find a way of removing high carbon contents to make iron products less brittle.



Clifton Suspension Bridge, Bristol, UK.

In around **1050 AD** the precursor to the modern Bessemer Process is developed. This process decarbonized the metal through repeated forging under a cold blast.

Although this process was far less efficient that Bessemer's later development it would form one critical stage in the development of our knowledge of the metallurgy of iron and steel.

The most important development was made by Henry Bessemer in **1856.** He managed to find a way of using oxygen to reduce the carbon content in steel, thus creating the modern steel industry.

7. Sailed Ships Opened Up the Oceans

The very first depiction of a sailed ship dates back to around **3300 BC** in an Egyptian painting. These early boats featured a square sail as well as banks of oars.

As they were confined to the Nile River and depended on winds within the narrow channel it was vital to retain oars during times of insufficient wind speed.

This combination dominated early ships for centuries reaching heights in technological advancements with the triremes of the classical period.

The first sails were probably made of animal skins but these were replaced by woven reed mats and eventually cloth in predynastic Egypt.

Later, sails were made of woven flax fiber in Europe which is still used today though cotton has largely replaced it.

Sailed ships would enable mass exploration of the seas and open up new trade routes. They would, in effect, shrink the world and allow previously disconnect nations to exchange goods and knowledge.

They would also enable nations to expand their influence around the world and, in some cases, become the workhorses of empire.

Incentives like these would further drive advancement in ship technology and mechanical engineering to the present day.

8. The Printing Press Industrialised Book Making

The printing press was one of the most important inventions for mechanical engineering and the population at large. Johannes Gutenberg's machine was groundbreaking in its own time and set the stage for enormous advancements made during the Renaissance and Industrial Revolution.

Movable type printing had been around for some time before Gutenberg, notably in China, but his device was the first to mechanize the process of applying text and images to paper en masse.

Gutenberg's press was modeled on the ancient wine presses of the Mediterranean and in fact, was made from a modified wine press. It was also developed on the existing presses of the medieval period.

His press worked by rolling ink over a pre-arranged raised surface of movable text held within a wooden frame. This was then pressed against a sheet of paper to create a copy.

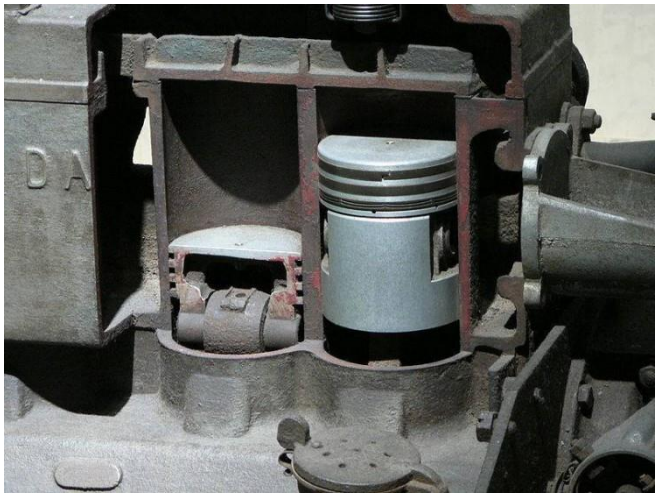
This process was vastly more efficient than other presses of the time not to mention the previous process of hand copying books.

The press would allow books to be produced more quickly, and, most importantly, cheaper, enabling more and more people to afford to buy them. This would mark a watershed in human and engineering history.

9. The Piston is a Vital Component of Reciprocating Engines

The invention of the piston is widely credited to French physicist, Denis Papin in **1690 AD**. His design for a steam piston engine was built upon by later inventors like Thomas Newcomen and James Watt during the **18th Century**.

Its invention, along with other advancements in steam engine technology, would mark the 'true' beginning of the industrial revolution.



Pistons in a display engine.

Pistons tend to be contained within a cylinder that is made air-tight by use of piston rings. In modern engines, the piston serves to transfer force from expanding gas in the cylinder into reciprocating motion on a crankshaft.

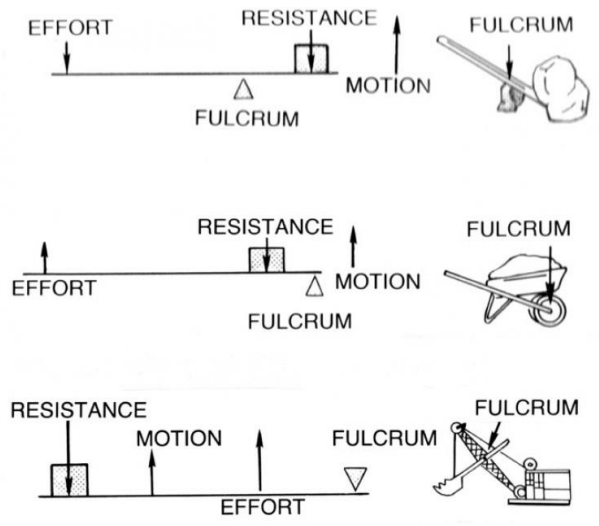
This process is effectively reversed when applied to pumps.

Today pistons are essential components in many reciprocating engines, pumps, compressors and other similar devices.

10. Levers Give You Mechanical Advantage

"Give me a place to stand, and I shall move the Earth with it' is a remark of Archimedes who formally stated the correct mathematical principle of levers" - Pappus of Alexandria.

The lever, yet another simple engine, consists of a beam (or rigid rod) pivoted on a fixed hinge or fulcrum. Levers are incredibly useful devices that can be used to provide mechanical advantage to move very heavy objects with relatively little effort, otherwise known as leverage.



Types of the lever.

Depending on where the fulcrum is located as well as the load and effort, levers can be divided into three types:-

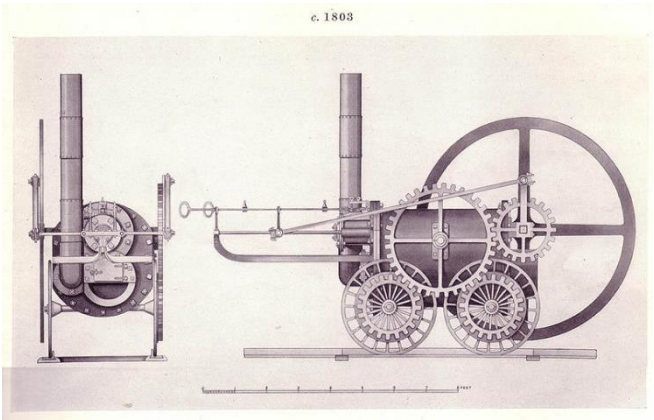
- Class 1 levers are those where the fulcrum is located in the center of the beam. Examples include a seesaw or a crowbar.

- Class 2 levers are those where the load (resistance) is located in the middle. Examples include a wheelbarrow or brake pedal.

- Class 3 levers are those where the effort is located in the middle. Examples include tweezers or even your own jaw.

Levers are first identified in the works of Archimedes in the **3rd Century BC**,

11. The Locomotive Revolutionized Transportation Forever



Trevithick's Coalbrookdale locomotive.

Richard Trevithick, in **1801-1804** built both the first steam carriage and an experimental steam locomotive in Pen-y-Darren, Wales, UK. He later sold the patent and in **1804** revised his original version to successfully carry **10 tons of iron, 5 wagons, 70 men for about 10 miles**.

This trip took just over **4 hours** meaning his locomotive clocked up an eye-watering **2.4 miles per hour**. This made it the very first steam locomotive to produce actual practical work.

The locomotive would go on to literally transform the face of industry and transportation the world over.

12. Inclined Planes or Ramps Make Lifting Easier

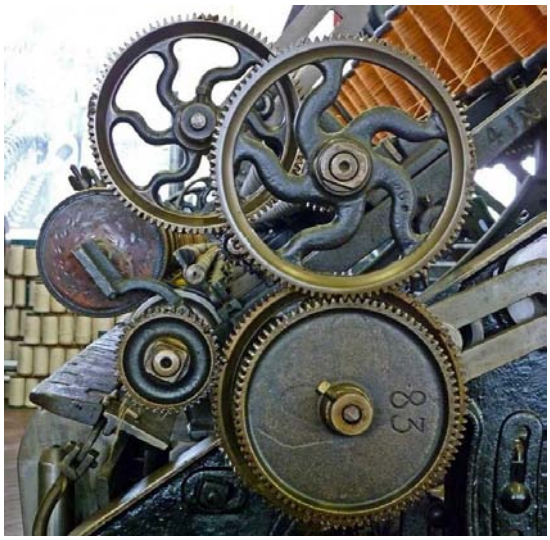
The humble yet immensely important ramp, or inclined plane, is another of the fundamental six simple machines that allows heavy loads to be moved vertically with relatively little effort. They are widely used in many applications from loading goods into trucks to disabled access ramps.

Moving an object up an inclined plane requires less force than lifting it straight up at a cost of an increase in the distance moved. The mechanical advantage for ramps is equal to the ratio of the length of the sloped surface to the height it rises.

The screw and wedge are other simple machines that can be considered variations on the inclined plane or ramp rather than discrete forms.

13. Gears and Cogwheels Transmit Torque With Ease

Gears or cogwheels are integral components of any rotating machine that allow for the change in speed, torque or direction of any power source. They are one of the fundamental mechanical engineering innovations in history.



Any change in torque with the use of gears and cogwheels necessarily creates a mechanical advantage thanks to the phenomenon of the gear ratio.

A gear can mesh with a linear toothed part, called a rack, producing translation instead of rotation.

It is unclear exactly when gears and cogwheels were first invented but some credit Archimedes. Today, gears are present in many moving systems and machines from bicycles to ship engines.

14. The Bearing Helps Reduce Friction

The bearing is another fundamental machine element that has come to define mechanical engineering. These devices allow the constraint of relative motion in one direction or plane whilst simultaneously reducing friction between moving parts.

Bearings come in many shapes and sizes and range from components holding shafts or axles in place (plain bearing) to more complex systems like ball bearings.

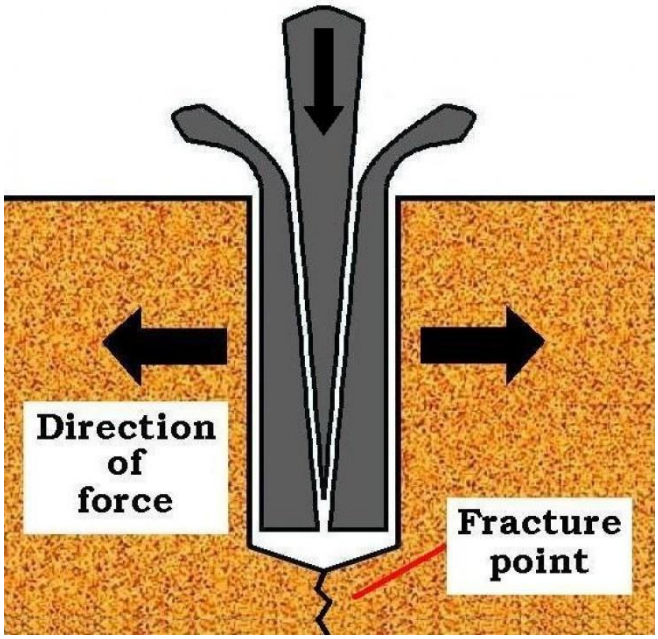
Modern-day sophisticated bearings often demand the highest level of precision and quality in manufacturing.

15. The Wedge Is Great For Breaking Things

The wedge is another simple machine and fundamental innovation in mechanical engineering. They have been used since prehistorical times for activities like splitting logs (axes) or rocks (chisels).

Wedges are defined as movable inclined planes that can be used to separate two objects (or portions thereof), lifting objects or holding them in place via the application of force to the wide end. The wedge's shape, therefore, converts one input force into perpendicular forces **90 degrees** to the inclined surfaces.

The mechanical advantage achieved by any wedge is dependent on the ratio of its length to thickness. In other words wide, short wedges require more force but produce a quicker result than a long, low angled wedge.



16. Electrical Motors Convert Electricity Into Motion

Motors are electronic machines that convert AC or DC electrical current into rotational movement. Most common electrical motors work through the interaction of a magnetic field and winding currents to generate a force.

The basic principle behind electric motors, Ampere's Force Law, was first described by Ampere in **1820** and was first demonstrated by Michael Faraday in **1821**. One of the first practical motors was created by Hungarian physicist, Anyos Jedlik in **1828**.

Motors are found in many applications around the world from industrial fans to power tools to computer disk drives.

Cutaway of a modern induction motor.

17. Springs Are Great For Storing Energy

The spring is, simply an elastic object that can store mechanical energy. They tend to be made of steel and come in many designs but most commonly in coiled forms.

Whenever a spring is disturbed from its resting position, when stretched or compressed, it tends to exert an opposing force approximately proportional to its change in length.

Small springs can be made from winding pre-hardened material whilst larger springs are usually made by annealed steel that is hardened after production.

In history, non-coiled springs were common, like the bow, but coiled springs began to appear around the **15th Century.** Today they have many applications from vehicle suspension to slinky toys.

18. Parallel Motion

Parallel motion is a mechanical linkage that was first invented by James Watt in **1784.** It was developed for use on his double-acting Watt steam engine and replaced the previous Newcomen beam and chain setup.

His new engine allowed power to be harnessed in both the upward and downward strokes of a piston effectively doubling the efficiency. It was termed "parallel motion" by Watt because both the piston and the pump rod were required to move vertically, parallel to one another.

It would prove immensely successful and became a critical innovation that helped define mechanics today.

19. Screws Convert Torque to Linear Force

Screws are yet another simple machine used since antiquity. They tend to consist of a cylindrical rod with one or more helical spiraling threads or ridges on the outside.

These ingenious mechanical engineering innovations convert rotational motion into linear force. Screws can also be perceived as a very narrow inclined plane, or ramp, that is wrapped around the cylinder.

Famous early examples include the Archimedes screw that was used an early form of a water pump.

Screws, like ramps, levers, and pulleys, allow a force to be amplified. In the case of the screw, it provides a mechanical advantage for converting a small torque (rotational force) into a large axial force on a load.

Its mechanical advantage changes depend on the distance between the screw's threads, aka pitch. They are widely used today as fasteners or as basic pumps, presses and as precision devices.

(Christopher McFadden / INTERESTING ENGINEERING, May, 03rd 2018, https://interestingengineering.com/19-mechanical-engineering-innovations-that-helped-define-mechanics-today?_source=newsletter&_campaign=Yq8Eeq0Nv905W&_uid=9wdL9JEwej&_h=9480fc0933eb231a0575c535417bef075ed6e805&utm_source=newsletter&utm_medium=mailing&utm_campaign=Newsletter-03-05-2018)

35 Inventions That Changed The World

From ancient tools to the latest digital advances, human inventions that changed the world and transformed life on the Earth.

From ancient tools to the latest digital advances, human inventions and technologies have shaped civilizations and transformed life on the Earth. As expectations and capabilities evolve, each new generation possesses its own set of innovative thinkers. Right from the invention of the wheel to the development of Mars rover, several inventions are revolutionary.

Most major inventions don't have one inventor. Throughout the years, many innovative inventors have had their hand in both the elevation and evolution of an invention.

Here is a list of our top picks of revolutionary inventions that changed the world:

Wheel

The wheel stands out as the OG of engineering marvels and one of the most famous inventions that influenced numerous other things. This primitive technology made it easier for all of us to travel. From the archeological excavations, the oldest known wheel is from Mesopotamia, around 3500 B.C. As a result of advancement in the new and innovative design of wheels, industrialization could take root. The wheel serves a vital purpose in our lives, and we couldn't imagine the world without them.

Compass

Created for spiritual and navigational purposes, the earliest compasses were most likely invented by the Chinese in around 1050 BC. It was made of lodestones, which is a naturally magnetized iron ore. The invention of the electromagnet in 1825 lead to the development of the modern compass. The invention of the compass certainly helped modern navigation more than our GPS-needing culture could understand.

Automobile

Although the foundation to the modern car year was laid in 1886 by German inventor Karl Benz, Cars did not become widely available until the early 20th century. Henry Ford innovated mass-production techniques that became standard, with Ford, General Motors, and Chrysler. However, he certainly wasn't the only person to develop the horseless carriage. The history of the automobile reflects a worldwide evolution. Dozens of spin-off industries blossomed creating thousands of new jobs. Oil and steel became two well-established industries. Vehicle production and sales are one of the major indicators of the economic status. Moreover, it influenced the technological advances in petroleum refining, steel making, paint and plate-glass manufacturing, and other industrial processes.

Steam Engine:

Thomas Savery patented the first practical steam engine in 1698. It was one of the greatest inventions made by a man making him one of the people who have changed the world. Later in 1781, James Watt patented an improved steam engine and went on to fuel one of the most momentous technological leaps in human history during the Industrial Revolution. During the 1800s these engines lead to an improvement in transportation, agriculture, and manufacturing industries. Later, the steam engine's basic principle set the stage for innovations like internal combustion engines and jet turbines, which prompted the rise of cars and aircraft during the 20th century.

Concrete

Concrete is the one of the most widely used man-made material. It's a composite material composed of rough composite bonded together with a fluid cement which hardens over time. Most concretes used are lime-based, asphalt concrete, and polymer concretes. Earlier, Limestone was used as a crude cement. As the materials and combinations improved, modern concrete was invented. One of the key ingredients of concrete is cement. The foundation to cement was laid in 1300 BC. Middle eastern builders coated the outside of their clay fortresses with a thin, and moist burned limestone, which chemically reacted with gasses in the air to form a hard, protective surface. Around 6500 BC, the first concrete-like structures were built by the Nabataea traders or Bedouins in the southern Syria and northern Jordan regions.

By 700 BC, the significance of hydraulic lime was known, which led to the development of mortar supply kilns for the construction of rubble-wall houses, concrete floors, and underground waterproof cisterns. By 3000 BC, the Egyptians were using early forms of concrete to build pyramids.

In 1824, the most used Portland cement was invented by Joseph Aspdin of England. George Bartholomew had laid down the first concrete street in the US during 1891, which still exists. By the end of 19th century, the use of steel-reinforced concrete was developed. In 1902, using steel- reinforced concrete, August Perret designed and built an apartment building in Paris. This building a wide admiration and popularity to concrete and also influenced the development of reinforced concrete. In 1921, Eugène Freyssinet pioneered the use of reinforced- concrete construction by building two colossal parabolic-arched airship hangars at Orly Airport in Paris.

Petrol

Without gas, there couldn't be the first industrial revolution in the automobile industry. Gasoline is a fuel derivative of oil, which is shortly called "gas" in the United States and "petrol," in other places around the world. To be more specific, petrol is a transparent, petroleum-derived liquid that is used as an essential fuel in internal combustion engines. Petrol is the natural by-product and the invention here we are talking about is the numerous processes to improve the quality. Do you know, gas was initially discarded? During 1859, in Pennsylvania, Edwin Drake dug the first oil well and refined the oil to produce kerosene. Although the distillation produced gas, he discarded it as he was unaware of it. Until 1892, the prominence of gas wasn't recognized. The first gas pump was manufactured by Sylvanus Bowser on September 5, 1885. The year 1970 gained attention towards environmental protection.

Railways

Railways is a mode of transport, which can carry a large number of passengers with ease of comfort and/or heavy loads to long distances. Modern trains history is around 200 years old, which revolutionized the way we travel. Distant lands become possible, industries are powered with an infinite amount of raw materials. Earlier mode of transport was carts pulled by animals. During 1500 -1800, wagon ways were common in Europe, which was used in mining. After the invention of Steam engine, more researchers were carried out throughout the world for a better design.

The commercial appearance of train networks came in the late 1820s, and the pioneer in that field was inventor George Stephenson, with his design 'Rocket', the most famous early railway locomotive. This gained rapid expansion across newly acquired lands. In 1821, Stephenson was appointed as an engineer for the construction of the Stockton and Darlington railway, which was opened as the first public railway in 1825. The grand success of "Rocket" and opening of the Stockton to Darlington railway line energized railway industry. Railways reached another important chapter in the history, with the invention of Diesel Engine.

Airplane

On December 17, 1903, Wilbur and Orville Wright achieved the first powered, sustained and controlled airplane. While flying machines had been dreamt up since da Vinci's time, the Wright Brothers became the biggest successes. Beginning with gliders, the duo laid the foundation for modern aeronautical engineering. Additionally, new business boomed along with a number of people being trained to fly planes.

The possibility to fly over thousands of miles in less time would not have been made possible if the aircraft were not invented.

Fire

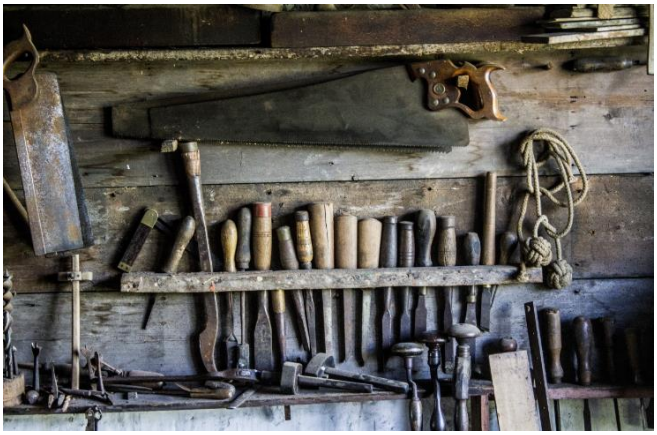
Though fire is a natural phenomenon, its discovery marked a revolution in the pages of history. All thanks to our ancestors for leading us to the controlled use of fire which helps us from colorful lighting to delicious cooking. In addition, the biography of various landscapes was altered by fire. Ancient people might have become acquainted with fire derived from natural sources. Later came the processes of making fire artificially. This remarkable control of fire happened during Early Stone Age by Homo erectus. The earliest evidence comes from Kenya region. Although fire could have been used about 1 million years ago, evidence of cooked food is found from 1.9 million years. From the past to the present Fire has been in rituals, agriculture, cooking, generating heat and light, signaling, various industrial processes, cremation, and as a weapon or medium of destruction.

Nail

The sophisticated human life would not have been possible without the invention of a small nail. They provide one of the best clues in determining the age of historic buildings. Prior to the invention of nails, wood structures were built by geometrically interlocking adjacent boards. The invention of nails goes back to several thousand years and was possible only after the development of casting and shaping a metal. Around 3400 BC, Bronze nails were found in Egypt. According to the University of Vermont, the hand – wrought nails were a norm until the 1790s and early 1800s. By 1913, 90 percent of nails produced in the U.S. were steel wire nails. Other types of nails include pins, tacks, brads, and spikes with wire nails being popular.

Tools

The usage of tools started 2.6 million years back in Ethiopia. Anthropologists believe the use of tools became an important step in the evolution of mankind. Earlier materials such as sticks and stones made tools. The invention of machine tools advanced the industrial revolution. Imagine how would we build or maintain previous innovations without a handy hammer.



Light Bulb

The energy we use today at home and office is a bright idea from more than 150 years ago. Pioneered in the early 19th century by Humphry Davy, electric lights developed throughout the 1800s and was one of the most influential, great inventions of all times. Edison and Swan patented the first light bulb in 1879 and 1880. In the mid-1980s, CFLs hit the market. But the drawbacks such as high cost, bulky, low light output, and inconsistent performance made them less prominent. Currently, LEDs offer the best energy savings on the market.

However, the invention of the bulb electrified new businesses. It also led to new energy breakthroughs such as power plants, electric transmission lines, home appliances etc.

Electricity

Electricity has become the basic need for day to day life. It's been there around all along but the practical applications to effectively use it were invented. Although many use electricity, how any of you the know the evolution of electricity? In , Alessandro Volta discovered the first practical method of generating electricity. 1831is marked the year of major breakthrough for electricity. A British scientist Michael Faraday discovered the basic principles of electricity generation. The electromagnetic induction discovery revolutionized the energy usage. Street lights were some of the earliest attention gaining equipment. With the rise in electricity usability, now it stands as a backbone of modern industrial society. With increased mobility, human life has become dependent on electricity.

Battery

The prehistoric battery dates back the Parthian empire, which might be 2,000 years old. The old battery consisted of a clay jar filled with a vinegar solution, into which a copper cylinder surrounded iron rod was inserted. These batteries might have been used to electroplate silver.

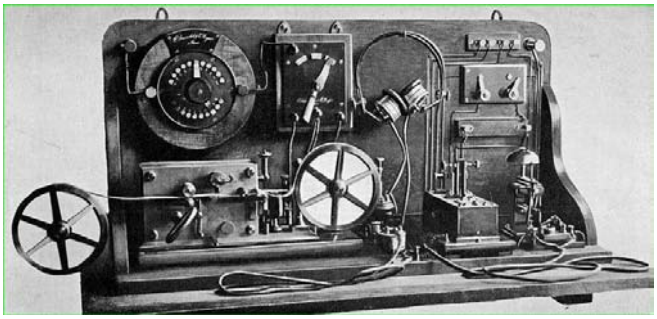
The inventor of the first electric battery is Alessandro Volta. He also laid the foundation of Electrochemistry. The mass production of the first electric battery began in 1802 by William Cruickshank. The history of batteries marked a remarkable date in 1859, with the invention the first rechargeable battery based on lead acid by the French physician Gaston Planté. The Nickel-Cadmium (NiCd) battery was introduced in 1899 by Waldemar Jungner.

Printing press

Before the Internet's ability to spread information, the printing press helped information travel throughout the globe. Developed around 1440 in Mainz, Germany, Johannes Gutenberg's machine improved on already existing presses. By 1500 Gutenberg presses were operating throughout Western Europe with a production of 20 million copies. By 1600, they had created over 200 million new books.

Morse Code and Telegraph

The telegraph was developed around 1830 - 1840 by Samuel Morse and other inventors, which revolutionized long-distance communication. The electrical signals were transmitted by a wire laid between stations. In addition, Samuel Morse developed a code, called Morse code, for the simple transmission of messages across telegraph lines. Based on the frequency of usage, the code assigned a set of dots (short marks) and dashes (long marks) to English alphabet and numbers. The telegraph laid major foundations for modern conveniences like telephones and (some scholars argue) coding for the Internet.



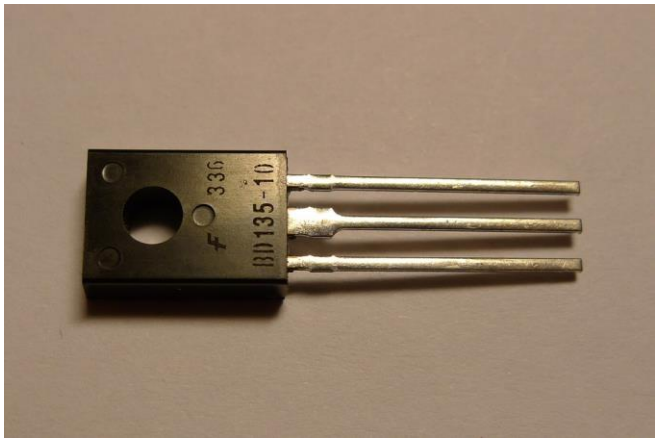
Steel

While the early ages used stone, bronze, and iron, it was steel that fired the industrial revolution. As per archaeological excavations, earliest known production of the metal dates back to 4,000 years. The invention of Bessemer Process (a technique for creating steel using molten pig iron) paved the way for the mass production of steel, making it one of the biggest

industries on the planet. Now steel is used in the creation of everything from bridges to skyscrapers.

Transistors

The transistor is an essential component in nearly every modern electronic gadget. In 1926, Julius Lilienfeld patented a field-effect transistor, but the working device was not feasible. In 1947 John Bardeen, Walter Brattain, and William Shockley developed the first practical device at Bell Laboratories. It then won the trio 1956 Nobel Prize in physics. Transistors have become a fundamental piece of the circuitry in countless electronic devices including televisions, cell phones, and computers making a remarkable impact on technology.



Antibiotics

Antibiotics saved millions of lives by killing and inhibiting the growth of harmful bacteria. Louis Pasteur and Robert Koch first described the Antibiosis (phenomena of antibiotic drug) in 1877. In 1928, Alexander Fleming set the first leap in antibiotics by identifying penicillin, the chemical compound with antibiotic properties. Throughout the 20th century, antibiotics spread rapidly and proved to be a major living improvement, fighting nearly every known form of infection and protecting peoples' health.

Contraceptives

Prevention of pregnancy has a long and determined history. The history of contraceptives dates back to 1500 B.C, where ancient Egypt women would mix honey, sodium carbonate and crocodile dung into a thick, solid paste called pessary and insert it into their vaginas before an intercourse. However, many researchers believe that several old world birth control methods are not effective and indeed could be fatal. The first known form of condom (a goat bladder) was used in Egypt around 3000 B.C.

In 1844 Charles Goodyear patented the vulcanization of rubber, which led to the mass production of rubber condoms. In 1914 with a monthly newsletter called "The Woman Rebel", Margaret Sanger, great female educator from New York state, first coined the "Birth control" phrase. Later, Carl Djerassi had successfully created a progesterone pill, which could block ovulation. The Pill raised an international revolution and was a huge hit.

X-ray

Of course, x-rays are a phenomenon of the natural world, and thus can't be invented. But they were discovered accidentally. The invisible was made visible in 1895. X-ray is undoubtedly one of the epoch-making advancement in the field of medicine. All credits to physicist Wilhelm Conrad Rontgen. While testing whether cathode rays could pass through glass, he noticed a glow coming from a nearby chemically coated screen. Because of their unknown nature, he named it as X-rays. Through his observation, he learned that X-rays can be photographed when they penetrate into human flesh. In 1897, during the Balkan war, X-rays were first used to find bullets and broken bones inside patients. In 1901, he received Nobel prize in physics for his work.

Refrigerator

Over the last 150 years, refrigeration offered us ways to preserve food, medicines, and other perishable substances. Before its conception, people cooled their food with ice and snow. James Harrison built the first practical vapor compres-

sion refrigeration system. However, the first widespread refrigerator was the General Electric "Monitor-Top" refrigerator of 1927. While it helped to rev up industrial processes, it became an industry itself.

Television

Television! A small box with enormous information that changed entertainment and communications forever. The invention of the television was the work of many individuals. Although TV plays an important part of our everyday lives, it rapidly developed during the 19th and the 20th century. The first television camera was invented by two men without knowing that they both are working on the same one (No TV to communicate them the news); Vladimir Zworykin and Philo Taylor. In 1884, Paul Gottlieb Nipkow created and patented the first television which he called the electromechanical television system. Though Color TV was not a new idea, in 1925 Zworykin filed a patent for an electronic color television system. Over time, television will gain political importance as every country started to share their political agenda through it. TV also became a food way of preserving peace and order.

Camera

The camera is undoubtedly one of the most cherished creations. Cameras have witnessed many phases of evolution – camera obscura, daguerreotypes, dry plates, calotypes, film to SLRs and DSLRs. In 1826, Joseph Nicéphore Niépce used a sliding wooden box camera made by Charles and Vincent Chevalier to click the first permanent photograph. With the technological advancements, Digital cameras were introduced to save pictures on the memory cards rather than using films.

The history of the digital camera began with Eugene F. Lally idea to take pictures of the planets and stars while traveling through space. Later, Steven Sasson a Kodak engineer invented and built the first digital camera in 1975. Though the digital camera ruled over the traditional camera, the most revolutionary aspect has been the advent of the camera phone. Now, every smartphone has an inbuilt camera and is able to take images. With the growing demand, video recording was also made a part of it. At present, the camera comes with inbuilt GPS system and real-time geotagging options. Freeze the great moments from your life in the form of photographs with better quality and superior handling digital camera. One doesn't have to look much further than a photo album to see that cameras are one of the great inventions that changed the world.

Computer

Major shoutout to the mechanical engineer Charles Babbage for laying the foundation to this remarkable and most reliable invention. In the early 19th century, the "father of the computer" conceptualized and invented the first mechanical computer. Although there's no single inventor of the modern computer, the principle was proposed by Alan Turing in his seminal 1936 paper. Today, computers stand as the symbolic representation of the modern world.

Email

During 1969, shortly after the creation of ARPANET, experimental email transfers between separate computer systems began. Before email, sending an important document overseas involves a chaotic process. Now communication is one click away. The first substantial use of email began in the 1960s. By mid-1970s, it had taken the recognized form. The present-day most of the official business communication depends on email. Now, email is available on plenty friendly web interfaces by providers such as Gmail, Outlook, Yahoo, Hotmail, etc. This excellent medium of communication is well adopted by millions of people.

Internet

Unlike the bulb or the telephone, the Internet has no single "inventor." Instead, it has evolved over time. It started in the United States around the 1950s, along with the development

of computers. Since the mid-1990s, the Internet has had a revolutionary impact on technology, including the rise of electronic mail, instant messaging, voice over Internet Protocol (VoIP) telephone calls, and two-way interactive video calls.

World Wide Web

The Internet is a networking infrastructure. Whereas the World Wide Web is a way to access information over the medium of the Internet. The father of the World Wide Web is a British Computer Scientist, Tim Berners-Lee. While working as a software engineer at CERN in Geneva, Switzerland, Tim noticed that the difficulty in sharing information. In 1989, this leads to a proposal "Information Management: A Proposal". However, it was not immediately accepted. By October 1990, three Tim laid the foundation to the web through HTML, URL, and HTTP technologies. April 1993, marked an important step in the history of Web. The decision to use the web for free was announced. To this day, the Web gleamed an encyclopedic wave of inventiveness. The web rapidly changed the traditional way and influenced the development of various industries. For example, it led to the development of online education and economy; the best way to promote your company in 2017 is through Google search. People can read or watch any types of content online whether through a site or social media such as Facebook and Twitter.

Banknote

From materials like livestock to precious metals and coins, currency took various forms throughout the history. Due to frequent shortages of coins, banks issued paper notes as a promise against payment of precious metals in future. The idea of using a light-weight substance as money originated in China during the Han Dynasty in 118 BC. Through travelers, Europe was introduced to this system in the 13th century. The switch to paper money relieved governments during crisis time. Thus, it changed the face of the global economy with a vital step in a new monetary system.

Credit Cards

During the dawn of 20th century, people paid for everything with cash. The idea of credit cards started around 1950 by Ralph Schneider and Frank McNamara, founders of Diners Club, to consolidate multiple cards. While technology continues to advance, the idea of paying for daily purchases with a card has now become the norm.

ATM

The invention of ATM (Automated Teller Machine) is amongst the most important inventions ever made. In the present world, ATMs steered the banking into a new concept of self-service. According to the ATM Industry Association (ATMIA), there are now over 2.2 million ATM machines installed worldwide. Using ATM, customers make a variety of transactions such as cash withdrawals, check balances, or credit mobile

phones. Many experts believe that the first ATM was the creation of Luther Simjian, called Bankograph. In 1967, John Shepherd-Barron came up with a bright idea of money vending machine, which was implemented a London bank called Barclays. Earlier machines used paper vouchers instead of plastic cards. The customer entered an identification code and can draw a maximum of £10 at a time. Dallas Engineer Donald Wetzel devised the first automated banking machine in the U.S.

Telephone and Mobile Phones

"Mr. Watson, come here, I want you." On March 10, 1876, these were the first words spoken by telephone inventor Alexander Graham Bell through his device to his assistant Thomas Watson. Telephone history conceivably started with the human desire to communicate far and wide. With the arrival of the mobile phone in the 1980s, communications were no longer restrained. The clever invention of cellular network supported the revolution of the telephone industry. Starting from bulky mobiles phones to ultrathin handsets, mobiles phones have covered a long way so far. John F. Mitchell and Martin Cooper of Motorola demonstrated the first handheld device in 1973. Scientists continue to create new ideas that will further help users.

Robot

Robotic devices often perform complicated, repetitive, and sometimes dangerous tasks. The word Robot evokes various devices ranging from a cooking device to the Rover. The word "robot" first appeared in R.U.R. (Rossum's Universal Robots), a play was written by Czech playwright Karl Capek in 1921. Coincidentally, the word "robotics" was also coined by a science-fiction writer Isaac Asimov in his short story "Runabout", published in 1942. Around 3000 B.C, human figurines were used to strike the hour bells in the Egyptian water clocks. This marked the first mechanical design. As the time flew, more designs and devices were evolved. But Robotics advanced scientifically in the 20th century.

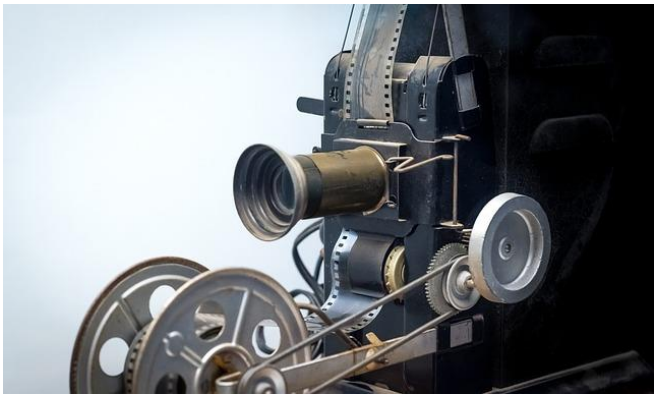
The foundation to modern robots was laid in the 1950s by George C. Devol, who invented and patented a reprogrammable manipulator called "Unimate," from "Universal Automation." In the late 1960s, Joseph Engleberger acquired the patent and modified them into Industrial robots. This effort made him "the Father of Robotics." Who knows! Someday robots might outsmart us and make us completely technology dependents. They are truly inventions that changed the world!

Guns

For some guns might be a sensational invention while for others it might be a dreadful invention. Weapons have been the primary tools since ancient age. But, it is an undeniable fact that the Guns have revolutionized the world. The earliest usage of a firearm might have been in China during the 13th century CE. In earlier days, guns were fired by holding a burning wick to a "touch hole" in the barrel igniting the powder inside. The first mechanical gun is the matchlock, which dates to 1400s. By the 12th century, the technology started spreading to Asia, followed by Europe. The problem of loading and reliability was solved by the invention of a hand-driven machine gun called Gatling gun. It was invented by Richard J. Gatling during the American Civil War. As the tech continued to evolve, each following model became more deadly.

Films

Almost everyone loves to watch movies of various sorts like a love story, comedy, drama, horror, suspense, action, fiction, biography etc. A film is also called a movie, motion picture, theatrical film, photoplay, flick. The name "film" originates from the fact that a photographic film has been the medium for recording and displaying motion pictures. An Early inspiration for movies were the plays and dance, which had elements common to film: scripts, sets, costumes, production, direction, actors, audiences, and storyboards. Later in the 17th century, the lanterns were used to project animation, which was achieved by various types of mechanical slides.



Much later in 1839, Henry Fox Talbot makes an important advancement in photography production. The year 1846 was important for the development of motion pictures. The first movie ever made is the horse in motion. In March 1895, the first film with a Cinématographe camera was shot on La Sortie de leucine Lumière a Lyon (Workers leaving the Lumière factory at Lyon). With time, the movies evolved with sound, music, color, and advanced technology.

(Alekhya Sai Punnamaraju / INTERESTING ENGINEERING, November, 25th 2016, https://interestingengineering.com/35-inventions-that-changed-the-world)

Καταπράσινοι κήποι από όλο τον κόσμο

Ανθισμένοι κήποι δημιουργούν μια πανδαισία χρωμάτων

Ένα μήνα πριν αποχαιρετίσουμε την άνοιξη, ανακαλύπτουμε διάσημους κήπους από όλο τον κόσμο που εντυπωσιάζουν με την έκταση και τα μοναδικά χρώματα τους.

Οι κήποι αυτοί αποτελούν αξιοθέατα για χιλιάδες τουρίστες που τα επισκέπτονται και αποθανατίζουν εντυπωσιακές φωτογραφίες.

Το **Ανάκτορο των Βερσαλιών** που βρίσκεται στο Παρίσι δεν είναι γνωστό μόνο για την αρχιτεκτονική και την ιστορία του κτιρίου, αλλά και για την τεράστια έκταση κήπων που απλώνεται μπροστά του. Αγάλματα και συντριβάνια συνυπάρχουν αρμονικά με την ανθισμένη πρασινάδα που χαρακτηρίζει τον κήπο.

Ο **Βοτανικός κήπος Villa Taranto** που βρίσκεται στην Ιταλία, χαρίζει μοναδικούς περιπάτους στους ολάνθιστους διαδρόμους με τα χρωματιστά λουλούδια να κλέβουν την καρδιά όσων λατρεύουν την άνοιξη.

Ο **Κήπος της Κοσμικής Θεωρίας** όπως ονομάζεται βρίσκεται στη Σκωτία και εκτός από θαυμασμό, προκαλεί και ίλιγγο στους επισκέπτες που αντικρίζουν μοναδικά σχήματα. Στολισμένο με λίμνες, γέφυρες και αρχιτεκτονικά έργα παραμένει μια ξεχωριστή εμπειρία για όποιον το επισκεπτεί.

Οι **κήποι Keukenhof** της Ολλανδίας μαγεύουν τους πάντες με τα εκατομμύρια ανθισμένα λουλούδια με τις διάσημες τουλίπες να πρωταγωνιστούν με χάρη και άφθονα ζωντανά χρώματα.

Με φοίνικες και ορχιδέες, ο **κήπος Suan Nong Nooch** στην Ταϊλάνδη είναι ένα χάρμα οφθαλμών.

(in.gr, 4 Μαΐου 2018,
http://www.in.gr/2018/05/04/plus/photo-gallery/kataprasinoi-kipoi-apo-olo-ton-kosmo)

Πάνω από 40.000 είδη φυτών συναντά κανείς στο **Βοτανικό κήπο Kew** του Λονδίνου.

This Baffling Optical Illusion Features A Spinning Arrow That Always Points Right

A professor in Tokyo published a video on Instagram showcasing a mind-bending optical illusion using a small plastic arrow.

Optical illusions are always fascinating. They trick our brain to perceive things differently than they actually are. Optical illusions are indeed a reminder that things that we see are not always as they seem.

A recent video on Instagram published by physicsfun brings another excellent example of optical illusion designed by Sugihara, a mathematics professor, and an award-winning illusion artist.

https://www.youtube.com/watch?time_continue=1&v=oWfFco7K9v8

The video shows a tiny arrow made up of plastic pointing in the right direction. When this arrow is rotated 180-degrees to point it towards left, you'll notice that it is still pointing in the same direction.

While this may seem like a magic trick, the always-right arrow is actually tricking your brain to perceive it that way. This brain-bender was first proposed by Sugihara in a 2016 paper published in the Journal of Symmetry.

He described it as an "anomalous mirror symmetry" that is generated by an optical illusion. These types of objects do not obey the rules of typical mirror symmetry.

That is, in reality, the object points in one direction, but in the opposite direction in reflection. This impossible symmetry cannot exist physically but can be perceived by human vision systems because of an optical illusion.

However, Sugihara showed that anomalous mirror symmetry can be generated by designing ambiguous cylinders, which are neither perfectly circular nor perfectly angular.

"When we see the object and its mirror image, however, what we perceive does not necessarily obey this physical law, because what we perceive is the result of image processing in our brains," Sugihara mentioned in the paper. "Hence optical illusion arises."

If you look closely, the arrow isn't actually an arrow. In reality, it is an oval shaped object made up of different curved surfaces. The edges of each surface meet at the center.

Viewing this object at a certain angle and with suitable lighting conditions creates an optical illusion that tricks your brain to consider these curves as angles. This is essentially due to our brain's preference towards interpreting retinal images as 3D objects in right angles.

In his paper, Sugihara has demonstrated in detail the use of such nature of our brains using different geometrical shapes that appear different in the original posture and in the mirror image.

The always-right arrow isn't the only optical illusion example. The video below demonstrates another mind-bending illusion through the use of ambiguous cylinders.

A set of plastic squares appears to circles in the mirror and simultaneously turns into squares when rotated.

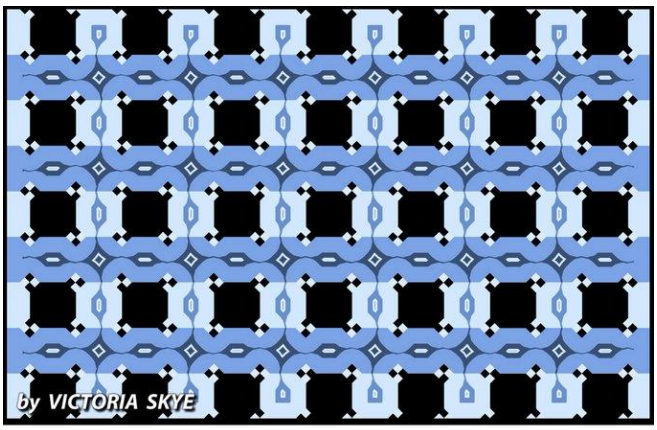
The professor has won twice in the Neural Correlate Society's Best Illusion of the Year Contest. With his novel idea, he believes that the visual effects created with such unordinary change of the appearance of the object might be used for new artistic presentation.

(Kashyap Vyas / INTRESTING ENGINEERING, May, 08th 2018, https://interestingengineering.com/this-baffling-optical-illusion-features-a-spinning-arrow-that-always-points-right)

This Incredible Optical Illusion Is So Deceiving, It Even Fools Its Creator

Victoria Skye's new version of the famous the Cafe Wall optical illusion became a viral sensation for its mesmerizing and deceiving patterns.

When you come across a deceiving image, it's just impossible not to wonder how the illusion works. And consequently, one part of your conscious mind tries to straighten up that deformed image. This is exactly the case for this latest optical illusion image created by Victoria Skye. Her own version of the famous optical illusion, the Cafe wall illusion by Richard Gregory, became an online viral sensation simply for its mesmerizing and deceiving patterns. Previous versions of the cafe wall illusion that dates back to 1898 have also been discovered but Skye's modern take on this vintage optical illusion is one to behold.



CAFE WALL OPTICAL ILLUSION
Do the horizontal bars look like they bend and are at an angle?
Look again, because they dont bend. They are straight and in parallel rows.
The alternating target patterns, rows and colors all combine to trick your brain.

How exactly does an optical illusion work?

Skye's Cafe wall illusion is comprised of perfectly aligned horizontal and vertical bars and diamond patterns. The design's patterns are in parallel rows in both directions but it's the way they interact with each other that makes the illusion look so believable. The illusion artist explained just how the eyes are tricked into seeing inclined lines instead of the real straight figures. "The scientists say that the reason the illusion exists has to do with how the white and black edges interact in opposite directions along the straight edge, tricking the brain into thinking there is a slant in the line".

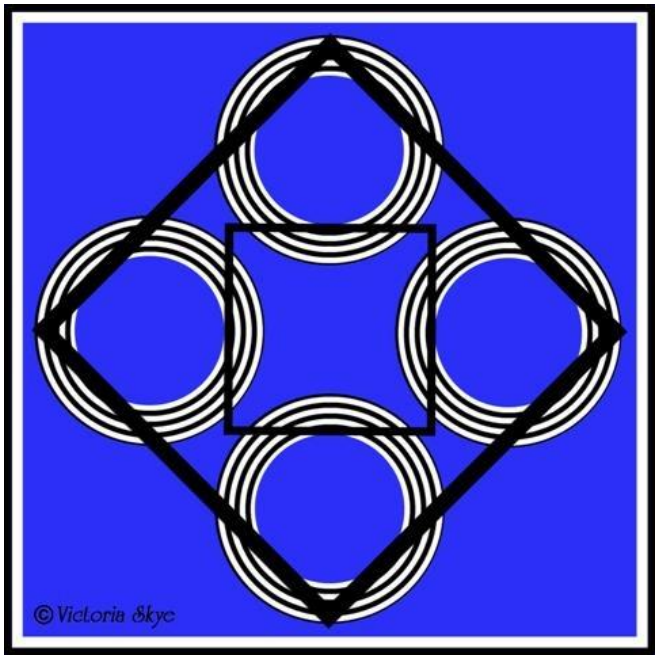
Without the contrasting interaction of the lines, Skye said the illusion loses its effect. "If you blur the image, the effect disappears because you cannot resolve the tiny white-black interactions once they are blurred, so the brain is no longer led down the garden path".

After trying to foolishly fix the apparent slants and inclinations of the straight edges in my head by squinting my eyes, I found myself slightly dizzy. Skye told Interesting Engineering that she intended for her design of the cafe wall illusion to be more extreme than previous versions.

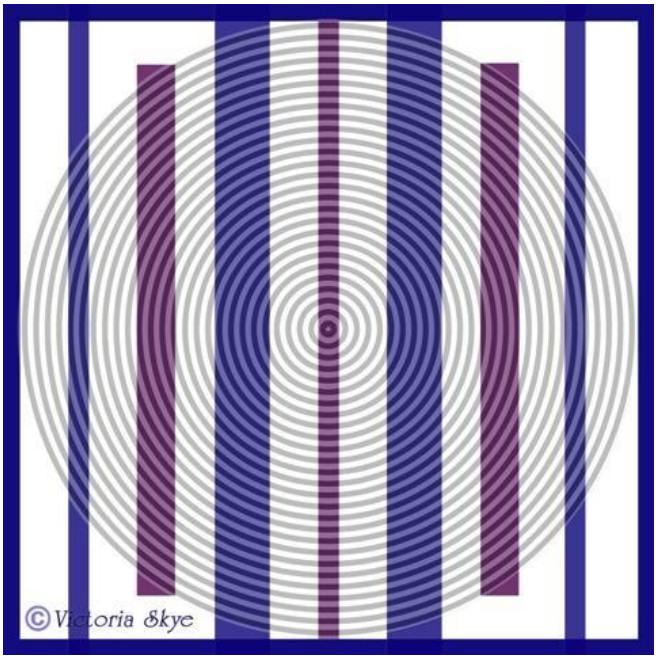
"Other versions of this effect were later discovered, such as the Café Wall variant, and in my version, I have summed two very strong versions of this effect to heighten the illusion even more".

Skye has asked illusion neuroscientists what this type of effect seen in her version of the cafe wall illusion is called. The artist was informed that the illusion in her version is categorized as the "twisted cord" effect, named after the very first version made by the Scottish physician James Frasier.

While browsing through Skye's website, we couldn't help but be in awe with some of the illusion artist's other works. Take this very subtle optical illusion art for example. If you focus on the corner edges of the large square it looks as if the lines are curving.



Or how about these straight blue and maroon stripes? The wave-like effect of the circles causes the straight lines to appear as if they are curves at their mid-points.



Apart from being a professional illusion artist, Skye is also a professional magician and entertainer based in Atlanta, Georgia. Skye has a background in drafting and design as well as being a woodworker, which she took after her father. Visit Victoria Skye's website victoriaskye.com to see more of her impressive optical illusion art works.

(Interesting Engineering, August, 10th 2017, https://interestingengineering.com/incredible-optical-illusion-deceiving-fools-creator)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

www.geoengineer.org

Κυκλοφόρησε το Τεύχος #155 του **Newsletter** του **Geo-engineer.org** (Μαϊου 2018) 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:

- Ocean Pines Drive sinkhole: limited options for its restoration
- Consecutive earthquakes rock Hawaii's Big Island as Kilauea Volcano continues to erupt
- New Guidance for San Francisco High-Rise Foundations
- TransEd Valley Line LRT Project
- Ongoing landslides hit Kryopigi village in Preveza, Greece (video)
- SPT: Standard Penetration Test Energy Calibration
- Pile Diameter Modeled Using Thermal Integrity Profiling Verified with Extracted Pile Measurements
- Hawaii's Big Island: The opening of 3 new fissures raises fears for an 'explosive eruption'
- Introducing EREF's Municipal Solid Waste eTextbook

http://campaign.r20.constantcontact.com/render?m=1101304736672&ca=f9eed04b-ad09-4643-8650-c316caa6e163

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2015 – 2018)

Πρόεδρος	:	Γεώργιος ΓΚΑΖΕΤΑΣ, Δρ. Πολιτικός Μηχανικός, Καθηγητής Ε.Μ.Π. president@hssmge.gr, gazetas@ath.forthnet.gr
Α' Αντιπρόεδρος	:	Παναγιώτης ΒΕΤΤΑΣ, Πολιτικός Μηχανικός, ΟΜΙΛΟΣ ΤΕΧΝΙΚΩΝ ΜΕΛΕΤΩΝ Α.Ε. otmate@otenet.gr
Β' Αντιπρόεδρος	:	Μιχάλης ΠΑΧΑΚΗΣ, Πολιτικός Μηχανικός mpax46@otenet.gr
Γενικός Γραμματέας	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Ταμίας	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr
Έφορος	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής ΤΕΙ Αθήνας gbelokas@teiath.gr, gbelokas@gmail.com
Μέλη	:	Ανδρέας ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής ΕΜΠ aanagn@central.ntua.grn
		Βάλια ΞΕΝΑΚΗ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. vxenaki@edafomichaniki.gr
		Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Ε.Μ.Π. mpanta@central.ntua.gr
Αναπληρωματικό Μέλος	:	Κωνσταντίνος ΙΩΑΝΝΙΔΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. kioannidis@edafomichaniki.gr
Εκδότης	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr

ΕΕΕΕΓΜ

Τομέας Γεωτεχνικής
ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΘΝΙΚΟΥ ΜΕΤΣΟΒΙΟΥ ΠΟΛΥΤΕΧΝΕΙΟΥ
Πολυτεχνειούπολη Ζωγράφου
15780 ΖΩΓΡΑΦΟΥ

Τηλ. 210.7723434
Τοτ. 210.7723428
Ηλ-Δι. secretariat@hssmge.gr ,
geotech@central.ntua.gr
Ιστοσελίδα www.hssmge.org (υπό κατασκευή)

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» Εκδότης: Χρήστος Τσατσανίφος, τηλ. 210.6929484, τοτ. 210.6928137, ηλ-δι. ctsatsanifos@pangaea.gr, editor@hssmge.gr, info@pangaea.gr

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» «αναρτώνται» και στην ιστοσελίδα www.hssmge.gr