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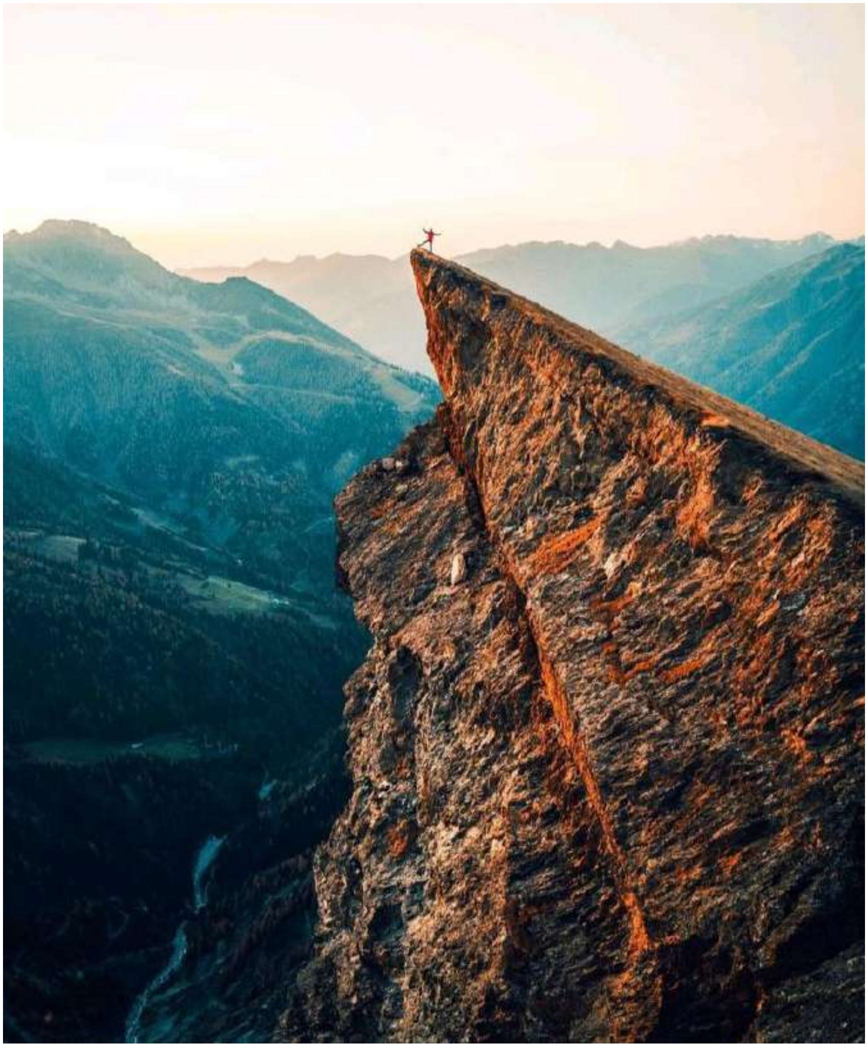

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ΑΡΘΡΑ

Jazz age geotechnical engineering part 6 case study St. Francis Dam failure

Review of *Foundations, Abutments and Footings* (Hool and Kinne, Eds., 1923), *Sections 5 (Underpinning) and 6 (Foundations requiring special consideration)*, featuring the St. Francis Dam as a case study

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Image 1: Aerial view of the St. Francis Dam's remnants after its March 1928 breach. *Source*: Harrison (2018).

The St. Francis Dam breach on March 12th, 1928, drowned over 450 victims. The plentiful paper trail left by the disaster has led over the subsequent century to many follow-up studies of it utilizing more modern geotechnical analyses. Thus, a consensus (never a given in historical studies) exists around what happened geotechnically at the scene of the St. Francis breach. Engineer William Mulholland, legendary de-signer of the Los Angeles Aqueduct, selected a site in the St. Francis Canyon about 40 miles northeast of the City of Angels for a reservoir to expand the city's water supply. Yet he never considered the site's engineering geology and thus over-looked a fragile, fracture-prone mica schist formation and a dormant paleo-landslide at the proposed structure's east abutment along with a friable sandstone formation along its proposed west abutment. As design progressed, Mulholland failed to incorporate adequate measures for uplift mitigation into his dam. During construction, he increased its height without also widening its base. The dam initially functioned well after its opening in 1926, but heavy rains in early 1928, kept the reservoir just inches below the dam's crest for weeks. Permeation through the fissile mica schist beneath the east abutment and the dam itself thus increased per Darcy's Law, and locals began noticing (Hundley and Jackson 2015, Rogers 1995).

Eventually, the growing leaks caught the attention of St. Francis's dam keeper, Tony Harnischfeger. On the morning of March 12th, he telephoned Mulholland with his concerns. Mulholland and deputy engineer Harvey Van Norman promptly headed out to the St. Francis Dam, which they toured with Harnischfeger for about 90 minutes. Mulholland and Van Norman noted the multitude of leaks at the east abutment that had caught the dam keeper's eye, as well as some more visible ones at the west abutment. While Mulholland told Harnischfeger to monitor the situation and check in with him regularly, neither engineer felt particularly concerned by what he had seen. However, at around 8 PM that evening, water level readings for the dam indicate that the St. Francis Reservoir started falling perceptibly. Eyewitnesses recalled no signs of increasingly severe leakage causing such a drop, and the reality was even more terrifying. The uplift forces against the St. Francis Dam were increasing as the swollen reservoir ever more deeply infiltrated the mica schist beneath and east of the massive structure, slowly raising it (Hundley and Jackson 2015, Rogers 1995).

Image 2: William Mulholland shows visitors around the newly finished St. Francis Dam, early 1927. *Source*: Harrison (2018).

Image 3: William Mulholland tours the swollen St. Francis Reservoir and its dam on the morning of March 12th, 1928. *Source*: Rogers (1995).

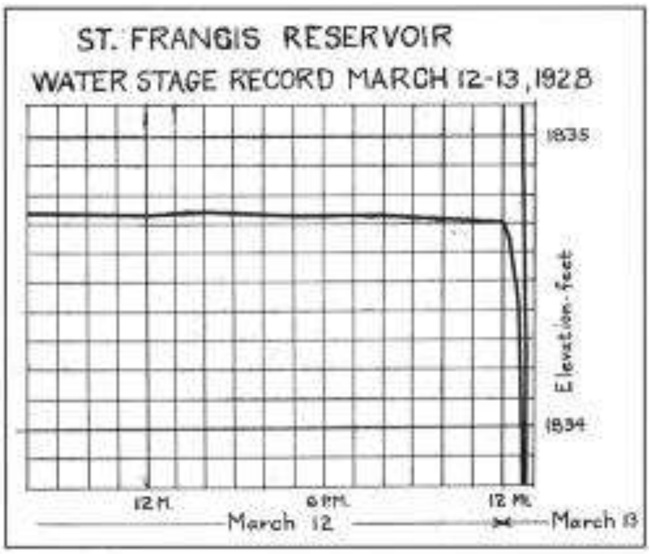
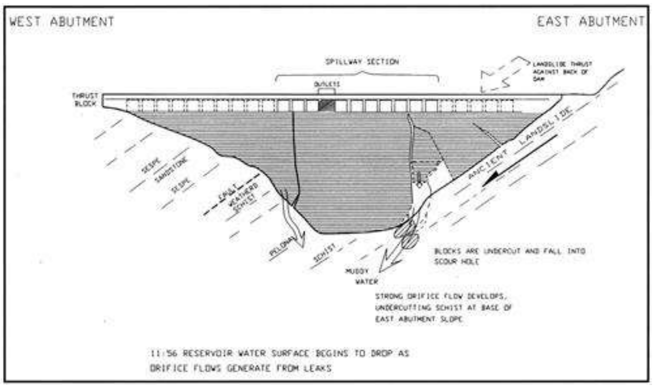
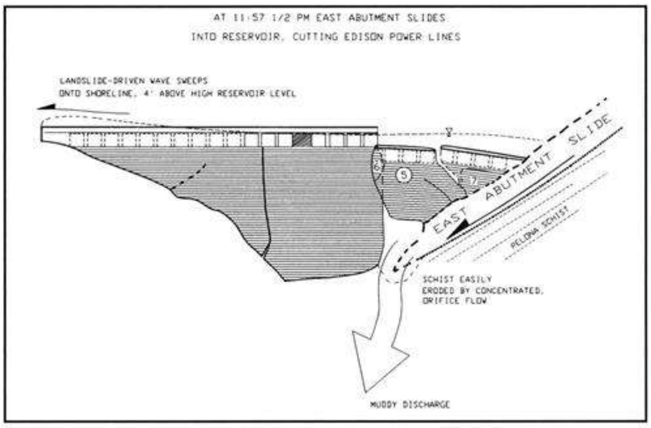


Image 4: Stencil of the tracing from the water level recorder atop the St. Francis Dam on the evening of March 12th, 1928. *Source*: Rogers (1995).

By roughly 11:55 PM, the increasing permeation through the mica schist was causing two compounding problems at the St. Francis Dam. A significant piece of the dam's east abutment, labeled as "Block 35" by investigators, broke away and effectively created a nozzle through which water cascaded from the reservoir. Simultaneously, the water seeping into the mica schist reactivated the ancient landslide, a problem only worsened by the "nozzle" that had formed at Block 35. At 11:57 PM, the entire east abutment gave way; the precise time is known because it knocked out a power line just downstream of the reservoir. The abutment's failure in turn removed the final check on the ancient landslide, which broke loose in full force and left a trail of mica schist fragments through the St. Francis Valley. The St. Francis Reservoir wrenched the dam's center away from its west abutment as its waters surged through the final breach. Once the reservoir had fallen about 40 feet, if not more, the crack between these two sections had grown wide enough that the roaring waters poured through it and the west abutment also gave way, although the delay resulted in considerably less damage along the valley's west side. All that remained standing when the Sun rose on March 13th was the dam's center, looming – in a macabre yet fitting way – like a tombstone over the scene. The mammoth crack in its base testified to just how close it, too, had come to being toppled by the torrent that had killed over 450 Californians, including Tony Harnischfeger (Hundley and Jackson 2015, Rogers 1995).





Images 5 and 6: Diagrams of the final breach of the St. Francis Dam's east abutment. *Source*: Rogers (1995).

The St. Francis Dam breach remains the second deadliest in American history, behind only the South Fork Dam breach of 1889 (see Johnstown Flood). A recap of famous dam failures written in the immediate aftermath of St. Francis prominently listed the South Fork breach, and the two disasters have some parallels. At the center of both stood men overconfident in their abilities to safely design and construct dams – Benjamin Ruff at South Fork, William Mulholland at St. Fran-cis. Shortcomings in the dam-building process at each site were apparent to others almost from the start but went unheeded. Following the disasters, public outcry was enormous.

More recently, both sites are now memorialized by the US government. In 2019, President Trump signed the St. Francis National Memorial into law on the disaster's 91st anniversary, and fundraising to build a visitors' facility at the breach site is ongoing (Bowers 1928, Hundley and Jackson 2015, SFDNMF 2021).

Image 7: The St. Francis Dam remnants today. *Source*: Charitan (2019).

Yet while history often rhymes, it doesn't repeat itself exactly, and several important distinctions remain between the South Fork and St. Francis Dam failures. William Mulholland, unlike Benjamin Ruff, had decades of engineering experience before designing the St. Francis Dam. Most of his prominent contemporaries in California civil engineering during the Jazz Age had on-the-job, not academic, training in their field, and Mulholland had previously supervised the design and construction of several dams which remain in service to this day. Moreover, the St. Francis breach was speedily investigated. Expert panels and independent engineers and geologists started their work within weeks of the dam's demise and published their findings within the year – in some cases, within a month. The St. Francis tragedy also got the wheels of government turning. The Roaring Twenties remain renowned for their laissez-faire economics, but the Progressive Era belief that government regulation was needed to safeguard public health and safety remained intact. Thus, in 1929, California tightened its laws to require that all dams be built under a licensed engineer's supervision. By then, William Mulholland – a titan in the Los Angeles engineering and water scene for nearly half a century – had been ushered into retirement; he died in 1935, shattered by the disaster (Hundley and Jackson 2015, Rogers 1995).

The St. Francis Dam breach also broke sharply from the Johnstown saga in the technical record it left behind. By 1928, civil engineering had matured vastly from where it had stood in 1889, well more than even the passage of four decades would indicate. The investigative reports on the St. Francis disaster make this clear, reflecting a degree of technical precision and breadth of scope far beyond what ASCE's 1891 South Fork Dam report contained. To be sure, the St. Francis reports – like the Johnstown report – were influenced by the powers that were and their interests. As of 1928, California's delegation in Washington, DC was working to steer the Boulder (now Hoover) Dam through Congress, and the failure of an extant concrete gravity dam in the Golden State threatened the new structure's prospects. It was undoubtedly for this reason that the Governor's Commission, the blue-ribbon panel investigating the St. Francis breach, concluded that the dam's surviving center section demonstrated the strength of concrete gravity dams while blithely skating past evidence that it, too, had nearly failed. Overall, though, the St. Francis reports avoided the egregious whitewashing and disingenuous interpretation of technical details that had permeated ASCE's South Fork Dam report. The St. Francis investigations' findings have since been debated and at times found incorrect, but the experts presented the technical facts of the case straightforwardly, and their assessments of what had happened were relatively well-developed, if not yet quantitative (Hundley and Jackson 2015, Wiley et al. 1928).

Image 8: William Mulholland, appearing staggered, tours the site of the St. Francis Dam shortly after its March 1928 breach. *Source*: SCV History (2017).

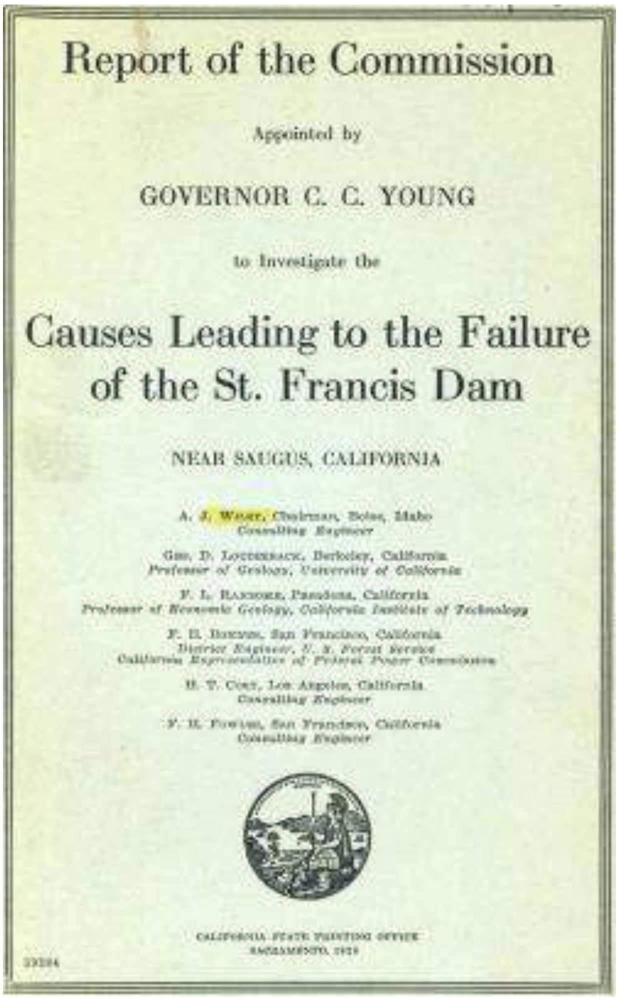


Image 9: Cover of the Governor's Commission blue-ribbon report on the St. Francis Dam breach, published April 1928. *Source*: Wiley et al. (1928).

Far more historical and civil engineering consensus exists on how the St. Francis Dam breached than on whether Mulholland's admittedly flawed design met the standard of care for its day. Some researchers have stated it did, stating that many dam engineers in the 1920s did not consider factors such as uplift. Others have disagreed, concluding that uplift concerns were increasingly of interest to Jazz Age civil engineers. An authoritative source on best practices for design and construction of dam foundations in the mid-1920s, when the St. Francis Dam was on the drawing board, would certainly shed new light upon the debate. *Foundations, Abutments, and Footings* by Hool and Kinne (1923), a readily available engineering text of its time, seems to be an excellent example of such a reference. Sections 5 and 6 of the book cover specialty topics in foundation engineering, including, fortuitously, dam foundations. These sections can thus provide a valuable perspective on contemporary best practices for engineering dam foundations and how many of these William Mulholland incorporated or overlooked as he oversaw the design of the St. Francis Dam in 1923 (Hool and Kinne 1923, Hundley and Jackson 2015, Rogers 1995).

Section 5 of Hool and Kinne (1923) was penned by Edmund Prentis. "Ted," as he was known, was the Chief Engineer of Spencer, White, and Prentis, the major New York City foundation engineering firm which did extensive work on the city's then-new subway system and on Yankee Stadium. Prentis and his colleague Lazarus White, a fellow contributor to Hool and Kinne (1923), literally wrote the book on underpinning several years later – 1931's Underpinning (see Hool and Kinne (1923), Section 3, Part A). "Underpinning," Prentis began, "is the art of installing new foundations, either in lieu of old ones, or under them, and is distinctly an art, rather than a science." While geotechnical work today is far more scientific and quantifiable than it was in 1923, it remains somewhat of an art as well, much more so than most subdisciplines of civil engineering. Prentis ably covers several valuable topics in his 12 pages, most notably the support of excavations and existing foundations (Prentis 1923).

Image 10: Edmund "Ted" Prentis, busy as usual, takes a telephone call in a headshot for his 1942 Moles Award. *Source*: Moles (1941).

Section 6 of Hool and Kinne opened with a subsection on deep basement foundations by Horace Baker, the Chief Engineer of Chicago firm F.D. Chase. He reviewed several case studies of basement construction and well-point excavation dewatering, most notably the Ritz-Carlton Hotel in Atlantic City, NJ. (The building still stands as a condo tower and gained some fame through the HBO drama series Boardwalk Empire, where it was the home of politician/gangster Nucky Thompson.) Baker's section was followed by one on foundation waterproofing by Earl Swanson, then an independent civil engineer in Chicago. Swanson spent his rather brief section discussing methods of waterproofing concrete basement walls; one such method, paraffin wax, remains in geotechnical use, albeit now for sealing Shelby tubes. Swanson's write-up was in turn followed by an even shorter subsection on retaining wall foundations by James Meem, who had previously contributed to Section 3 of Hool and Kinne (1923). Meem attempted to give his Section 6 pointers on retaining wall foundations a stronger theoretical basis than his notes on well foundations and cofferdams in Section 3. However, his valiant efforts were largely fumbling, as Meem – like geotechnical engineering writ large in 1923 – remained unaware of how effective stress worked (Baker et al. 1923).

Image 11: Hoses for well point dewatering snake through the excavation for the Ritz-Carlton Hotel in Atlantic City, NJ, c. 1920. *Source*: Baker et al. (1923).

A meatier subsection of Section 6 came from Philadelphia engineer Stephen Slocum, who discussed foundations for machinery. He correctly noted that such foundations required considerations from structural dynamics, such as resonant frequencies, and explained through a series of clear derivations how these could be incorporated into foundation design for turbines, stationary engines, looms, and other industrial equipment. Slocum knew of what he spoke, since he worked in 1923 for N.W. Akimoff, a firm specializing in the production of vibration-dampening bracing for heavy machinery. A century after Hool and Kinne (1923), Akimoff remains in business as the Vibration Specialty Corporation, and its technologies have been utilized in engines ranging from Model T Fords to the US Navy's nuclear submarines. While Slocum's expertise was undeniable, his lengthy discussion of the value of Akimoff systems in preventing common issues tied to excessive vibration of machinery foundations was clearly self-promotional. Modern geo-professionals are taught that such obvious commercialism in technical literature is unacceptable, and potential publications that cross this red line are usually rejected by journals and conferences. Still, the technical merits of the Akimoff technologies Slocum described were undeniable, as was his verve in covering them (VSC 2021).

Nestled between Baker, Swanson, and Meem's short, sweet write-ups and Slocum's longer, grandstanding-adjacent one was Charles Paul's subsection on dam foundations. Paul, an 1895 graduate of MIT, had worked on municipal water supply and filtration projects for the first decade of his career, then had spent another decade with the US Bureau of Reclamation tackling irrigation, canal, and dam projects. Notably, he had been the chief engineer for the design and construction of the Arrowrock Dam in Idaho, the world's highest dam upon its completion in the mid-1910s. In 1923, Paul was closing in on a decade as the Chief Engineer of the Miami Conservancy District in Ohio, a flood control organization founded after floods had devastated southwestern Ohio in 1913. (The District survives today.) Only the previous year, he had published a paper on his experiences with the District's hydraulic fill dams in the *Transactions of ASCE*. Paul's portion of Section 6 therefore provides an excellent benchmark for assessing the standard of care for dam foundation design and construction in 1923 and whether William Mulholland met it during his work on the St. Francis Dam (Baker et al. 1923, Marquis 1922, MCD 2025 B).

Image 12: Present-day view of the Lockington Dam, one of many dams designed and constructed for the Miami Conservancy District on the watch of Charles Paul. *Source*: MCD (2025 A).

Image 13: Future site of the St. Francis Dam, early 1920s. The contact between the sandstone (dark) and mica schist (light) formations is clearly visible in the foreground; the dam's ultimate site is marked with the letter "A". *Source*: Hundley and Jackson (2015).

"The main requirements to be considered for a dam foundation," Paul began, "are: bearing power, water tightness or control of seepage [,] prevention or control of upward pressure, prevention of sliding of the dam on its foundation or of the foundation itself, and protection against scour below the downstream toe or apron." He noted that the crucial nature of these considerations could scarcely be overstated, as "failure to understand foundation conditions, or to appreciate their importance, has often resulted in disaster." Paul then discussed foundation requirements for dams of various heights. For masonry or concrete dams over 200 feet tall, he declared (the St. Francis Dam would top out at 205 feet), "firm, hard rock, without open seams, fissures, or faulting," was "the only suitable foundation" for ensuring adequate bearing capacity, seepage control, and uplift prevention. Clearly, the friable sandstone and fissile mica schist at the site Mulholland had chosen hardly met this definition. Paul was surely unfamiliar with the St. Francis site, but he knew not every site would present ideal subsurface conditions for whatever dam engineers desired to build there, and he cautioned his readers accordingly. "Subsurface examinations become increasingly important as the character of the material is less reliable," Paul explained, "and special treatment is often necessary to meet the various foundation requirements" (Baker et al. 1923, Hundley and Jackson 2015).

"It is desirable," Paul wrote, "to have a careful geological examination of the foundation conditions," ideally one in the form of "an investigation and report by an expert practical geologist." The factors he listed as important ones for such a study to ascertain on a site included the bedrock's "probability of fissures and faulting, [and] former upheavals and disturbance" – in other words, historical geologic hazards such as paleo-landslides. Such a study at the St. Francis site would most likely have uncovered the vulnerability of the sandstone and mica schist formations to seepage, as well as the paleo-landslide flanking the proposed dam's east abutment (which several geologists readily observed at the site after the breach). However, William Mulholland neglected to consider the site's engineering geology as he began designing the dam. He and J.P. Branner, an esteemed Stanford geology professor (and mentor of future President Herbert Hoover), had briefly visited the site prior to design getting underway, but such a trip hardly qualified as a proper geologic study. The oversight was particularly egregious given that a decade earlier, workers constructing the Los Angeles Aqueduct under Mulholland's supervision nearby had complained of the mica schist's hazardous dip and its tendency to expand upon excavation (Baker et al. 1923, Rogers 1995).

Image 14: Close-up of the east abutment landslide at the St. Francis Dam site following the breach. *Source*: Rogers (1995).

Paul then went into detail about what a proper subsurface investigation for a dam entailed. He recommended the use of wash borings for soil samples, a common technique at the time (see Hool and Kinne (1923), Section 1). Paul added that these borings were most valuable if used in conjunction with test pits, which he noted – in a phrase as true now as then – "afford the only opportunity to inspect the material in place." Moreover, he noted that rock corings extending at least 20 feet were necessary to assess the character of the site's bedrock, such as its quality, potential faulting, and verifying its presence. Paul cited his experiences at the Arrowrock Dam as evidence of bedrock corings' importance. The cores there, he explained, the cores had encountered a layer of soil beneath a layer of bedrock, revealing the presence of a buried paleo-ledge that could have severely compromised the dam's foundation had it not been revealed. Paul noted that boulders could similarly be mistaken for intact bedrock with rock corings; modern geo-professionals might well add karstic formations to the list (Baker et al. 1923).

Image 15: Early stages of foundation excavation at the Arrowrock Dam, mid-1910s. *Source*: Baker et al. (1923).

Unfortunately, William Mulholland's site investigation for the St. Francis Dam fell far short of Charles Paul's guidelines. His engineers and workers excavated no test pits and performed only 4 or 5 borings for the dam. All these borings were concentrated along the proposed west abutment and extended a mere 14 to 16 feet deep. The men did conduct a crude falling-head permeability test in one boring, which Paul didn't describe in his write-up. While the design team performed additional exploration on the east abutment, their technique of choice likely did far more harm than good. In testimony to a coroner's jury after the St. Francis breach, multiple workers recollected excavating – partially with blasting powder – a tunnel about 30 feet long and "big enough for a man to work running a wheelbarrow" into the mica schist to assess its quality. Not until the construction of the dam began was the tunnel backfilled with concrete. Excavating a sizable tunnel into the mica schist using uncontrolled explosives and then leaving it open for a lengthy period could only have harmed the geological stability of the site and the dam. This was especially true given the mica schist's tendency to expand upon atmospheric exposure, which led the workers to refer to the formation as "heavy ground" (Hundley and Jackson 2015).

Image 16: Bedrock at the Arrowrock Dam between the completion of excavation and clean-off and concrete placement, mid-1910s. *Source*: Baker et al. (1923).

Paul next turned to how to properly excavate bedrock for a dam foundation, which he knew well from his work at the Arrowrock Dam. "The preparation of the rock foundation for a high masonry dam," he wrote (Paul used the terms "masonry" and "concrete" somewhat interchangeably in his subsection), "is one of the vital features of construction [and] all loose or soft rock should be carefully cleaned off and removed." Paul qualified his instructions to account for the susceptibility of some rock types to decomposition upon exposure. He explained that such rock should initially be excavated only to within a few inches of the dam foundation's intended limits and that the remaining material would most prudently be removed just prior to the placement of concrete. Alas, Paul's guidance on rock excavation seems to have gone unheeded at the St. Francis Dam site. The workers' testimony about their ill-advised tunnel into the mica schist is compounded in the historical record by photographs showing construction of the dam's foundation proceeding without proper clearing of talus and loose rock from the hillsides prior to pouring concrete (Baker et al. 1923, Hundley and Jackson 2015).

Image 17: The east abutment of the St. Francis Dam just before concrete placement, with loose mica schist clearly visible – a striking contrast with the Arrowrock Dam work. *Source*: Wiley et al. (1928).

Image 18: Onlookers take in the remnants of the Austin Dam after its failure, fall 1911. *Source*: Kline et al. (2021).

After this build-up, Charles Paul covered three key techniques for preventing uplift and seepage beneath dams: subsurface grouting, cutoff trenches, and uplift wells. "Prevention or control of upward pressure in masonry dams is a subject which has been under lively discussion for many years," he wrote, and "is not difficult usually." By 1923, civil engineers had been sounding the bugle of uplift warnings for over a decade, particularly after the uplift-induced Austin Dam breach had killed 78 people in north-central Pennsylvania in 1911. (Only a timely telephone call from a woman whose home overlooked the dam had spared hundreds more.) "It is a crime to design a dam without considering upward pressure," one prominent US civil engineer had declared in the wake of the Austin breach, and an article on addressing the issue appeared in the *Transactions of ASCE* the next year. Civil engineers were still disputing how best to compute it in 1923, but, as Paul wrote, "all are agreed that it must not be disregarded and should reasonably be provided for" (Baker et al. 1923, Hundley and Jackson 2015, Kline et al. 2021).

Paul discussed subsurface grouting first, noting that doing so for rock foundations beneath dams was "often resorted to as a matter of precaution. In fact," he elaborated, "it is standard practice in the construction of high masonry" and concrete dams. Paul proceeded to spend several pages discussing grouting techniques in a refreshingly organized manner compared to the somewhat slapdash write-ups on many geotechnical topics in *Foundations, Abutments and Footings*. Grouting had already been employed successfully at several major US dams by 1923, including by Charles Paul himself at the Arrowrock Dam in the mid-1910s. There, he had directed crews in drilling two lines of holes 30 to 40 feet deep along the length of the dam, one of which workers had then grouted. Later in the 1910s, Paul had supervised similar operations at the Lockington Dam for the Miami Conservancy District. (His handiwork there was superb; additional grouting was not required for another 90 years.) Paul knew from Darcy's Law that creating a grout curtain beneath a dam lengthened the flow path, *l*, of water under the structure, thereby decreasing the hydraulic gradient, *i*, and thus the total seepage below it. Yet the St. Francis Dam incorporated no program of foundation grouting despite the known potential for permeability issues in the "heavy ground" mica schist. In fact, no evidence has emerged that Mulholland and his lieutenants even considered undertaking such a program there (Baker et al. 1923, Geo-Solutions 2022, Hundley and Jackson 2015).

Image 19: Grouting operations for the outlet and spillway of the Lockington Dam near Piqua, OH, late 1910s. *Source*: Baker et al. (1923).

Paul also peered far into the geotechnical future at least once during his discussion of subsurface grouting. One particularly robust grouting method, he noted, involved "drilling holes, properly spaced, to the depth required, and grouting in reinforcing bars which will be carried up and tied into the masonry in such a manner as to effectually tie dam and foundation together." Paul observed that this technique both curtailed subsurface seepage and firmly anchored the dam to the subsurface strata underlying it. Modern geo-professionals, however, may well envision broader applications for this method – it constitutes the fundamental design of a micropile! Currently, these are understood to have originated in Italy following World War II. However, Paul's description of the technology indicates that the geotechnical history books may be due for some revision on this count (Baker et al. 1923, FHWA 2005).

Paul next gave his attention to the engineering of cutoff trenches for controlling seepage and uplift below dams. He noted that such trenches were most commonly excavated "across the foundation along the heel or upstream face of the dam" and "should be at least 3 or 4 ft. deep in any case, and should be continued up the abutments, and along the full length of the dam." For dams on softer rock, Paul added, "deep cut-offs or curtain walls of concrete are also desirable at both upstream and downstream faces of the dam." Paul knew of what he spoke, having designed constructed several cutoff trenches for his dams in the Miami Conservancy District. Yet William Mulholland once again missed the mark on this method of seepage and uplift mitigation. Carl Grunsky, a well-regarded civil engineer on the California water supply scene during the Jazz Age, noted during a March 1925 visit to the St. Francis Dam construction site that "there was no indication of trenching up the hillsides to provide vertical abutment faces." The situation was equally woeful in the dam's center, where the upstream portion of the foundation not only was excavated 8 feet *shallower* than the remainder but was not even excavated through overburden soils to bedrock. Mulholland and his St. Francis team could scarcely have made a less considered decision in this regard (Baker et al. 1923, Hundley and Jackson 2015, Rogers 1995).

Image 20: Cutoff trench (center) of the Huffman Dam near Fairborn, OH, in the Miami Conservancy District during its construction, late 1910s. *Source*: Baker et al. (1923).

Image 21: Excavation of the east abutment of the St. Francis Dam (near location of Image 17) showing absence of a cutoff trench – a vivid departure from the Huffman Dam foundation. *Source*: Wiley et al. (1928).

Finally, Charles Paul covered the civil engineering aspects of uplift wells for dam foundations. In most large dams of the age, he noted, it was "feasible to construct drainage galleries lengthwise of the dam [and] close to the upstream face," wherein uplift wells could be drilled "to provide relief for any upward [hydrodynamic] pressure which may exist." Paul himself had used the technique at the Arrowrock Dam, where his crews had drilled two rows of holes to rock along the future structure's foundation. After the workers had grouted one of the two rows of holes, they had used formwork to gradually extend the other row upward as the concrete dam and its drainage gallery were built. Nor was Paul alone in this regard, as many prominent dams of the era featured uplift wells. In fact, New Mexico's Elephant Butte Dam, constructed in the late 1910s, incorporated subsurface grouting, a cutoff trench, and drainage wells. Lamentably, William Mulholland and the St. Francis Dam design and construction teams came up short on this count as well, albeit by less than on others.

Mulholland did recognize the need for some uplift protection at St. Francis and included 10 wells 2 inches in diameter beneath the central 120 feet of the dam. Since it was 661 feet long, though, his design choice left 270 feet of the structure on either side of its center – i.e., both abutments – unprotected by such wells. Mulholland's token uplift wells bore unfortunate parallels to the 20 lifeboats the RMS *Titanic* had carried on its ill-fated maiden voyage just over a decade prior to 1923. The St. Francis Dam's handful of uplift wells and the *Titanic*'s handful of lifeboats sufficed only to check a box that safety measures had been included and not to make sure those measures were up to their intended tasks (Baker et al. 1923, Hundley and Jackson 2015).

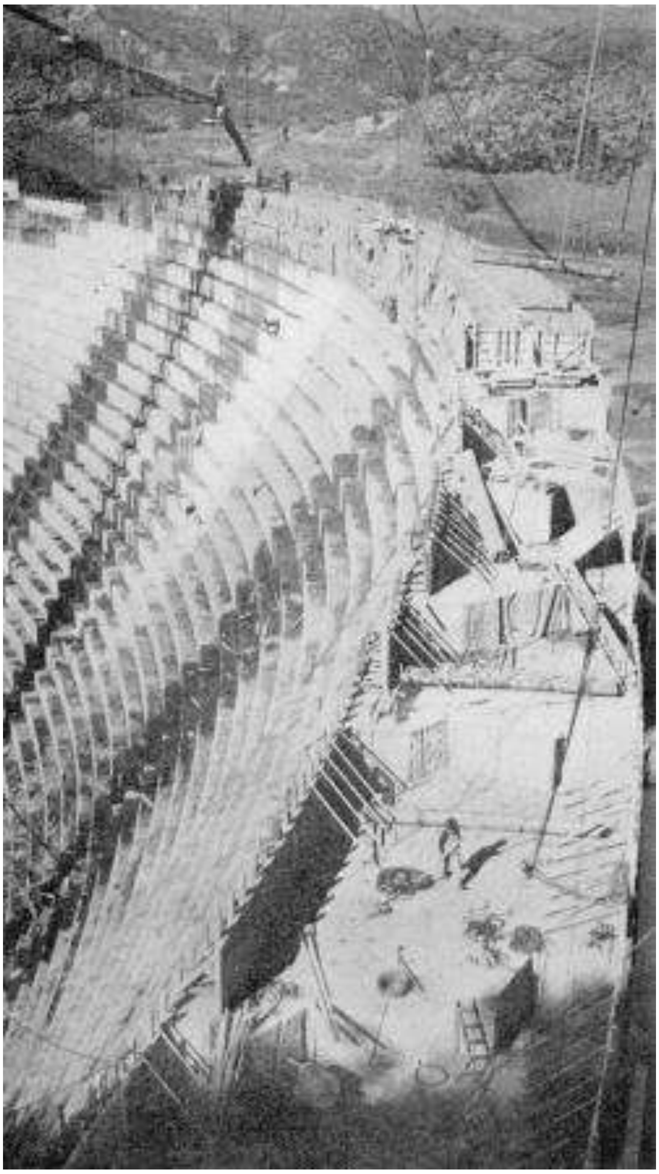


Image 22: Construction on the St. Francis Dam nears its end. *Source*: Wiley et al. (1928).

Collectively, Charles Paul's subsection of Section 6 paints a rather unflattering picture of William Mulholland's design of the St. Francis Dam. The subdiscipline of dam foundation engineering was clearly coming into its own by the Roaring Twenties, but Mulholland's work at St. Francis reflects an engineer badly behind his times in that regard. "The Chief," as his men knew him, failed to have his team conduct a detailed geologic study or subsurface investigation of his intended dam site, even when existing geologic information was readily available from other projects he had done nearby. The limited investigation he and his team did complete may well have been counterproductive, as the large tunnel they excavated into the mica schist on the east abutment site likely factored into the St. Francis Dam's demise. Nor did Mulholland incorporate sufficient means of warding off seepage and uplift issues into the structure's foundation. His design for St. Francis included neither subsurface grouting nor cutoff trenches and utilized only a dismal smattering of uplift wells. Finally, Mulholland's crews compounded their boss's design errors by doing a poor job excavating the dam's foundations (Baker et al. 1923, Hundley and Jackson 2015).

William Mulholland's 50-year engineering career included many feats of technical ingenuity, persistence in the face of adversity, and triumphing over long odds. Sadly, Section 6 of *Foundations, abutments and footing*s makes clear that his work at St. Francis fell dramatically short of the standard of care for the design and construction of dam foundations in the 1920s. In fairness, Mulholland was neither the first nor last civil engineer to fail to meet the best practices of their day and age, and geo-professionals must be ever on their guard against this peril. Indeed, the standard of care serves as a memorial to those who have suffered or perished when civil engineers have, wittingly or otherwise, failed to adhere to its previous iterations. Another such memorial stands in the form of engineering licensure laws. While California had such laws on its books prior to 1928, the St. Francis Dam breach justifiably heightened pressure on Golden State legislators to tighten these statutes, which they did the following year. Nearly a century on from the failure, such laws for civil engineering licensure – along with the standard of care and the crumbling remnants of the St. Francis Dam – stand as a stark reminder that the seal of a professional civil engineer is truly, as esteemed forensic engineer Roberto Leon has noted, a "license to kill" (Hundley and Jackson 2015).

Image 23: The St. Francis Dam remnants shortly after the structure's breach, March 1928. *Source*: Harrison (2018).

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(American Society of Civil Egineers / Geo-Institute, 16 May 2025, https://www.geoinstitute.org/news/jazz-age-geotechnical-engineering-part-6-case-study-st-francis-dam-failure)

Η ανακάλυψη μιας ανθρωποθυσίας στο ανάκτορο της Κυδωνίας

Η Μαρία Ανδρεαδάκη-Βλαζάκη αφηγειται στο Short Stories την ιστορία μιας συγκλονιστικής αρχαιολογικής ανακάλυψης στον λόφο Καστέλλι, στην Παλιά Πόλη των Χανίων

Ο λόφος του Καστελλιού από την θάλασσα (https://www.ertnews.gr/perifereiakoi-stathmoi/chania/simantika-archaiologika-eyrimata-ston-lofo-kastelli-sta-chania-apokalyfthike-anaktoriko-kentro/)

Το 2006 ξεκίνησα στο οικόπεδο της οδού Κατρέ 1 τη συστηματική ανασκαφική έρευνα στο λόφο Καστέλλι, στην Παλιά Πόλη των Χανίων. Τότε, δεν μπορούσα να φανταστώ τι θα ερχόταν στο φως. Εκεί αποκαλύφθηκε η δραματική θυσία του 1250 π.Χ. Περιελάμβανε –εκτός από 43 αιγοπρόβατα, δύο βόδια και τέσσερα γουρούνια– και μία νέα κοπέλα.

Το πρώτο ανθρώπινο οστό, ο ένας μηρός, ξεπρόβαλε την τελευταία μέρα της ανασκαφής του 2007. Ανεξήγητο γεγονός για την ομάδα μας. Σταδιακά, στις επόμενες ανασκαφικές περιόδους φανερώθηκε η υπόλοιπη απόθεση. Με κορύφωση την ανεύρεση, το 2012, του κρανίου της κοπέλας, διανοιγμένου από τις ραφές. Και περιστοιχισμένου από τα κρανία δύο αιγοπροβάτων και ενός χοίρου.

Ένα μακάβριο θέαμα που για μια εβδομάδα στοίχειωνε τον ύπνο μου. Ποιο ήταν αυτό το ανθρώπινο πλάσμα που τόσο βάναυσα διαμελίστηκε; Πώς αποφαίνομαι έτσι απλά και δηλώνω, ειδικά στον χανιώτικο κόσμο, ότι εδώ γίνονταν ανθρωποθυσίες στην κρητομυκηναϊκή εποχή; Πώς να διαχειριστώ ένα τόσο ευαίσθητο θέμα; Που εύκολα μπορεί να προκαλέσει το κοινό αίσθημα; Ανθρωποθυσίες στη μυκηναϊκή Κρήτη;

Και όμως η ανθρωποθυσία ήταν μπροστά στα μάτια μου. Όφειλα πλέον να το ανακοινώσω. Τα ευρήματα μας μιλούσαν ήδη για το τραγικό μυστικό. Οι μελέτες της ανθρωπολόγου και της ζωοαρχαιολόγου επιβεβαίωσαν τη θυσία. **Ο εντοπισμός από τους γεωλόγους του ενεργού ρήγματος -που διασχίζει εγκάρσια τον χώρο της ανασκαφής- εξηγεί το κατεστραμμένο δάπεδο της εκτεταμένης υπόστυλης αίθουσας**. Στα ερείπιά της φιλοξενήθηκε η απόθεση της θυσίας.

Τι συνέβη λοιπόν στα μέσα του 13ου αι. π.Χ.; Ένας φοβερός επιφανειακός σεισμός 6,5-7,5 Ρίχτερ γκρέμισε το ανακτορικό κέντρο της Κυδωνίας. Εξαιτίας του ενεργού ρήγματος, καταστράφηκε το ανακτορικό οικοδόμημα, δημιουργώντας τη συγκλονιστική εικόνα μιας τάφρου.

Οι κάτοικοι, έντρομοι από την καταστροφή και το ξεγύμνωμα της καρδιάς του ρήγματος, ωσάν μιας εισόδου προς τον Άδη, προσπάθησαν με θυσία να κατευνάσουν τις χθόνιες δυνάμεις. Παραμερίζοντας τμήμα του δαπέδου απόθεσαν τα σφάγια σε μεγάλα κομμάτια.

Τα σκέπασαν με πέτρες και πλάκες για να μην τα πειράξει κανείς. Μετασεισμός που ακολούθησε τα σφράγισε μέχρι τις μέρες μας.

Βαριά η ευθύνη της αποκάλυψης μιας θυσίας, όπου τα σφάγια –άνθρωπος και ζώα αδιάκριτα– διαμελίζονται και διασκορπίζονται στο έδαφος. Η νέα που θυσιάστηκε παραπέμπει σε θυσίες παρθένων, τόσο συχνές στις αφηγήσεις της αρχαίας ελληνικής γραμματείας και στα έργα των τραγικών ποιητών.

Η Ιφιγένεια, η Πολυξένη, οι κόρες του Λεώ, οι Υακινθίδες, η Άγλαυρος, κόρες βασιλιάδων, στην ίδια την Κυδωνία η Ευλιμένη, κόρη του βασιλιά Κύδωνα, θυσιάστηκαν σε δύσκολες στιγμές. Μοιάζει με παραμύθι η ιστορία αυτή, τόσο που καμιά φορά αμφιβάλλω και η ίδια για την ερμηνεία. Όμως όλες οι ενδείξεις οδηγούν σε αυτό το συμπέρασμα.

Με μια μεταφυσική ματιά, στα χρόνια των σταδιακών αποκαλύψεων πολλά συνέβησαν και σ’ εμένα την ίδια – άλλα θαυμάσια, άλλα δραματικά. Η συστηματική ανασκαφή μας ανταμείβει κάθε χρόνο με ανέλπιστα ευρήματα, από συγκλονιστικές εικόνες σεισμών μέχρι γεωμετρικά ειδώλια και θησαυρούς νομισμάτων.

Σήμερα, που κινδυνεύει η κορυφή του λόφου του μινωικού ανακτόρου από επαπειλούμενη μετατροπή της σε ξενοδοχειακή μονάδα, προσπάθεια που βρίσκει απέναντι τον χανιώτικο λαό, μου φαίνεται ωσάν ο λόφος από μόνος του να αντιδρά. Γιατί οι αρχαιότητες, αργά ή γρήγορα, εκδικούνται όσους τις επιβουλεύονται.

(SHORT_STORIES_GR, 06.11.2023, https://short-stories.gr/short/i-anakalypsi-mias-anthropothysias-sto-anaktoro-tis-kydonias/)

Hangzhou Century Center: Engineering a Landmark

Jin Chen, PE, SE

The Hangzhou Century Center, also known as "The Gate of Hangzhou," is a prominent urban development situated in the Xiaoshan District of Hangzhou, China. Positioned between the Hangzhou International Expo Center to the east and the Olympic Sports Center Training Hall to the west, the project is envisioned as a striking gateway to the city. This iconic development comprises two high-rise towers, each reaching a height of 310 meters, connected at their base by a 60-meter-span steel arch bridge. The surrounding commercial blocks form a dynamic mixed-use complex, offering office spaces, luxury hotels, and retail facilities.

With a total construction area of approximately 526,000 square meters—370,000 square meters above ground and 160,000 square meters below—the twin 63-story towers are designed to resemble the letter "H," a symbol of Hangzhou's identity. A suspended steel grid structure connects the two towers starting at the 21st floor, creating an expansive public space above the bridge, enhancing both the functional and architectural scope of the complex.

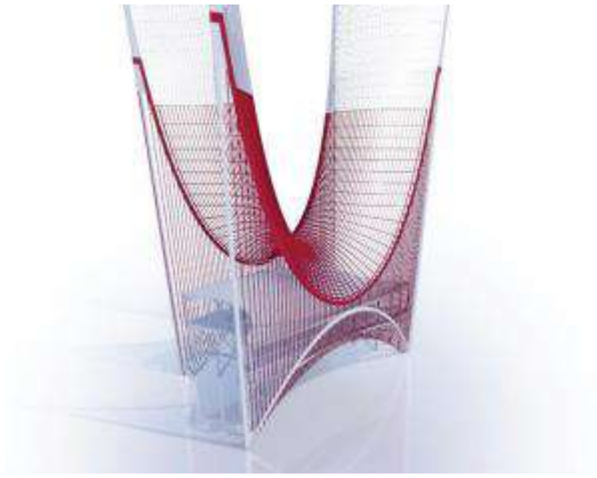
Towers and Bridge

Hangzhou is located in a region of moderate seismic activity and medium wind pressure. The lateral design of the towers' structural system is primarily governed by seismic effects. The structural system itself is a highly efficient and robust integration of distinct yet complementary components. It is designed to leverage the stiffness, mass, and damping characteristics of a rigid central core and a ductile perimeter moment frame, optimizing resistance to dynamic wind forces while efficiently dissipating seismic energy.

Left: Each tower has a central reinforced concrete core tube and a perimeter frame of reinforced concrete beams and composite SRC columns. Right: A steel arch bridge that spans 62 meters between the two towers is supported by rigid connections at the ground level, where it integrates with the steel-reinforced columns of the towers.

Each tower features a centrally located reinforced concrete core tube, which transitions from an elongated octagonal shape at the base to a rectangular form by the 44th floor. The core resists the majority of lateral seismic and wind loads. The perimeter frame is a composed of reinforced concrete beams and composite SRC columns which could provide the excellent ductile for seismic and minimize the sizes. The perimeter moment frame is proportioned to ensure effective load sharing, maximizing efficiency as the second defense system for seismic.

The towers' oval-shaped floor plans taper along their height, resulting in a highly dynamic, aerodynamically optimized massing with a rounded corners and tapered shape, highly integrated with architectural layouts. This shape helps to disrupt wind vortex shedding, thereby reducing wind-induced vibrations and loads, leading to significant material savings.



The suspended roof structure comprises bi-directional steel grid members with vertical curvature.

Each flat glass panel of the bridge roof is supported by a quadrilateral steel grid, with panel edges aligned to the grid lines

The floor system consists of one-way reinforced concrete beams and slabs within and beyond the core. Although cast-in-place concrete floors typically extend construction timelines, the contractor was able to implement a three-shift work schedule per day for concrete construction, whereas steel construction was limited to one shift per day due to local regulations. As a result, the concrete system did not delay the schedule while simultaneously achieving structural material cost savings.

Integrating the steel grid roof and glass panels was a key design challenge.

The steel arch bridge spans 62 meters between the two towers, elevating 34 meters above the ground. Comprising six parallel arch trusses aligned with the tower columns, the bridge is supported by rigid connections at the ground level, where it integrates with the steel-reinforced concrete columns of the towers. The horizontal thrust of the bridge is transferred to the core tubes of the towers via the continuous floor slab system at the ground level, ensuring stability and load distribution.

The steel bridge was finished in 6 months and the steel drape roof and side walls were constructed in 11 months during the pandemic time.

The bridge serves dual functions: a pedestrian walkway at the 6th floor and a banquet hall at the 3rd floor. The arches of the bridge are defined by the Funicular form-finding to minimize the bending moment under gravity. The diagonal braces are incorporated to enhance lateral stiffness since this building-type bridge still needs to meet with building structural control ratios. The bridge's natural frequencies are 1.23 seconds in the X-direction, 1.18 seconds in torsion, and 0.99 seconds in the Y-direction, ensuring its stability under dynamic loads and providing a resilient structure for varied use.

Drape Roof and Integrated Design

The suspended roof structure spans approximately 60 meters between the two towers, hanging from the 21st floor. It is composed of bidirectional steel grid members with vertical curvature optimized through the catenary geometry concept; each segment of the grid is straight with the H section. The horizontal curvature is carefully designed to simplify node connections and enhance the architectural aesthetics.

Horizontal restraint systems located on the 18th, 14th, and 11th floors provide lateral stability for the suspended roof and incorporate tension cables and compression struts. Vertical steel members support the side walls of the suspended structure, hanging from the edge beams of the roof. These vertical members are laterally restrained at the 6th and 3rd floors of the bridge but are free to move vertically, accommodating differential displacements.

The drape roof is one of the project's most innovative features, drawing inspiration from the natural shape of a hanging chain, which forms a catenary curve under its own weight. This geometry ensures the roof predominantly carries axial forces to minimize bending moments and optimize material efficiency, which contributes to both structural performance and sustainability.

Each grid node consists of a steel tube with four H-section members connected to it

The initial geometry of the longitudinal drape grid was derived from the classic catenary equation. However, this equation assumes uniform segment lengths and constant gravity loads per segment. Given the varying segment lengths and loads in the drape grid, iterative calculations and adjustments were required to account for the actual gravity loads at each node.

This process ensured the final catenary geometry efficiently supports its self-weight.

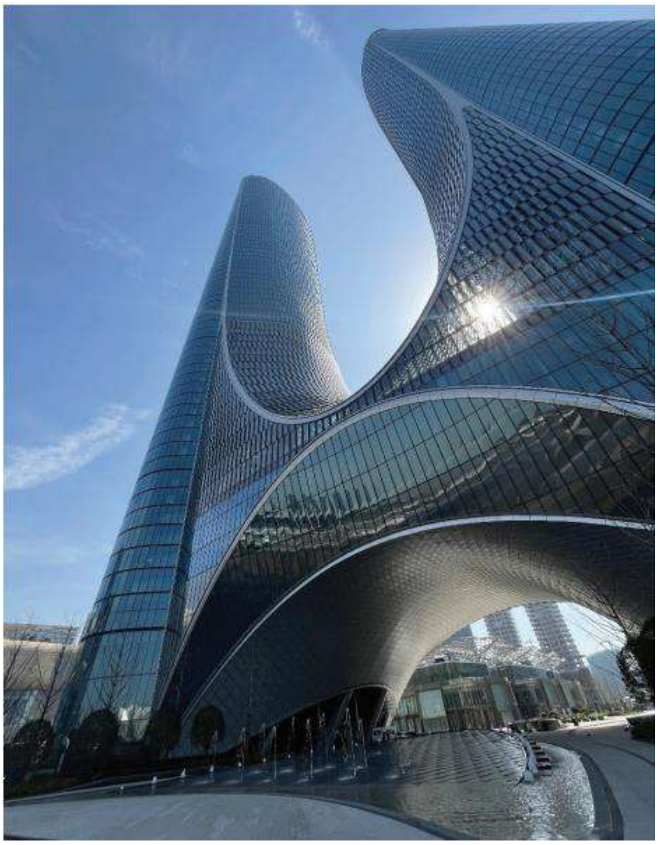
The integration of the steel grid roof and glass panels was a key design challenge, demanding precise coordination to balance structural integrity with aesthetic refinement. The objective was to maintain the majority of the glass panels in a flat configuration while accommodating the doubly curved geometry of the draped roof.

To achieve this, the roof's surface was designed using a scaled-translational approach, beginning with defining a central catenary curve, which is then subdivided into multiple straight-line segments based on the target glass panel dimensions. Due to the tapered form of the tower and different hanging ends, adjacent catenary curves span slightly longer distances. These adjacent curves are generated by scaling the central catenary—preserving the segmentation—and translating it to its designated location. This procedure is repeated to generate the series of catenary curves across the surface. Finally, corresponding division points between adjacent curves are connected with straight lines, forming a quadrilateral grid, which defines the layout for the glazing panels. This method ensured that the glazing panels remained perfectly flat while conforming to the overall curvature of the structure. Each glass panel was supported by a quadrilateral steel grid, with panel edges precisely aligned to the grid lines. The flatness of the panels was meticulously controlled through careful geometric calibration of the grid and strategic orientation of the steel members.

The optimized geometry allows 97% of the grid members to use standard H-section steel (HN300x150x6.5x9), with localized reinforcement (H300x150x10x25) at stress concentration areas. The total steel weight of the roof, including nodes, is approximately 700 tons.

The sidewall of the drape roof connects the edge of the drape, which is straight in plan, to the edge of the bridge structure, which is curved in plan. It also meets the towers along a line angled in elevation. The hanging mullions of the sidewall are designed to be as evenly spaced as possible while maintaining a funicular shape under gravity to minimize bending.

To achieve these design constraints, 3D graphic statics were employed. In this approach, force magnitudes within the structure are represented by the lengths of lines in a force diagram, while equilibrium at each node is ensured by the closure of force polygons. By imposing geometric constraints on these diagrams, a 3D funicular structure in equilibrium was developed.



The Greenland Hangzhou Century Center, between Hangzhou's International Expo Center and Olympic Sports Center, is an iconic landmark with its two 310-meter twin towers connected by a gracefully 'draped' skybridge

Although the structural logic of the sidewall precludes the use of entirely flat glass panels, the relatively shallow curvature ensures that cold-bent glass panel warping remains within acceptable limits, even under wind-induced deflections.

The grid nodes of the suspended roof are designed to simplify construction and ensure structural efficiency. Each node consists of a steel tube with four H-section members connected to it. The flanges of the H-sections are welded to circular plates at the top and bottom of the tube, ensuring continuity of the load path. The orientation of the I-section member axes is carefully specified to ensure that the webs of every I-section intersecting at a node align along a common line, known as the "node axis." This eliminates geometric torsion and simplifies detailing and documentation. The sidewall connections were designed as hinged joints, allowing for construction tolerances and accommodating differential displacements while maintaining structural integrity.

Wind Tunnel and Analysis

Wind tunnel testing was conducted to determine the wind loads on the suspended roof and side walls. The tests provided eight wind load cases for the structural design, with wind pressures ranging from -2.27 kPa to 1.73 kPa. The natural frequency of the suspended roof was controlled to be around 1 Hz to ensure accurate wind load predictions.

The maximum deformation of the suspended roof under wind loads is 132 millimeters, which is acceptable for a 60-meter span. The lateral deformation of the side walls at the connection points with the towers is 47 millimeters inward and 68 millimeters outward, within the allowable limits for the curtain wall system.

The deformation of the twin towers under wind and seismic loads has a minimal impact on the suspended roof due to the high stiffness of the towers relative to the roof structure. In the integrated structural model, the lateral deformation of the towers at the connection points with the roof is 30 to 50 millimeters, which has a negligible effect on the overall behavior of the grid roof. The porous grid roof reduces wind loads while promoting natural ventilation at the concourse level.

The deformation of the suspended roof is controlled to ensure the safety and functionality of the glass panels. The out-of-plane deformation of the panels is limited to 1/50 of the diagonal length, while the in-plane shear deformation is controlled by designing the panel connections to allow for relative displacements.

The structural performance of the suspended roof was evaluated using finite element analysis. The analysis considered gravity loads, wind loads, and seismic loads, as well as the interaction between the suspended roof and the twin towers. The results confirmed that the roof meets all design requirements, with sufficient stiffness and strength to withstand extreme loading conditions.

Construction

Following the completion of the foundation and basement, construction of the two towers commenced simultaneously from ground level. A climbing formwork system was utilized for the reinforced concrete shear wall core, which progressed approximately two floors ahead of the column, beam, and slab floor system. The typical construction pace averaged six days per floor. Upon reaching level 24, construction of the steel bridge began. The two cores were engineered to resist the thrust forces from the steel bridge. Each bridge arch was prefabricated in two segments at the shop, with the six steel arches erected first, followed by the installation of steel braces, columns, and floor members. The superstructure construction for both towers was completed in 13 months.

The construction of the drape roof presented several challenges, including the need for precise positioning of the grid members and the installation of the glass panels. The construction of the suspended roof involves the following steps:

1. Complete the main structures of the twin towers and the steel bridge.
2. Install temporary scaffolding system on the 6th floor of the top of bridge up to the 20th floor.
3. Assemble large segments 2x2, 2x3, 3x3 grid modules of the roof grid steel in the shop and lift them into position using cranes.
4. Install grid roof steel segments from the lowest mid strip of the roof.
5. Connect the edge beams of the roof to the side walls and install the vertical steel members.
6. Install the horizontal restraint systems at the 18th, 14th, and 11th floors.
7. Install the glass panels on the roof and side walls, ensuring uniform loading.

Conclusion

The Hangzhou Century Center project demonstrates the feasibility of using catenary geometry and advanced structural analysis techniques to design long-span suspended structures. The project's success provides valuable insights for future projects, particularly in the design of lightweight, efficient, and aesthetically pleasing structures.

The successful realization of the Hangzhou Century Center project would not have been possible without the dedication and expertise of the entire project team. Special acknowledgment is due to structural team members William Baker, Dane Rankin, Toby Mitchell, Han Ding, Max Cooper, and Ben Johnson for their innovative approach to architectural integration and structural aesthetics. Their collective efforts and seamless collaboration were pivotal in transforming this ambitious vision into a tangible landmark.

The suspended grid steel structure of the Hangzhou Century Center stands as a remarkable achievement in contemporary structural engineering. Through the innovative application of catenary geometry, advanced wind tunnel testing, and meticulous construction planning, the project has produced a structure that is not only highly efficient but also visually striking. Its success offers valuable insights for the design and construction of future long-span suspended structures and super-tall buildings, pushing the boundaries of engineering excellence.

STRUCTURE, May 30, 2025, https://www.structuremag.org/article/hangzhou-century-center-engineering-a-landmark/

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

ΕΛΛΗΝΙΚΗ
ΕΠΙΣΤΗΜΟΝΙΚΗ
ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

New Presentations Uploaded On The Channel Of HSSMGE On Youtube!

The recorded presentations of the speakers at the 1st Romania-Greece Seminar on Earthquake and Geotechnical Engineering in Bucharest, Romania, are now available at The Channel of HSSMGE on youtube (https://lnkd.in/dvjjGC8s)!

- Opening addresses (https://lnkd.in/d7YjxKjD)
- Loretta Batali (https://lnkd.in/dib5pj9B)
- Kyriazis Pitilaksis (https://lnkd.in/di84iB6H)
- George Gazetas (https://lnkd.in/dRTe6zT6)
- Giorgos Belokaw (https://lnkd.in/d3p-2sU3)
- Radu Vacareanu (https://lnkd.in/dS4S_eiy)
- Cristian Arion (https://lnkd.in/dVX22i-r)
- Alexandru Aldea (https://lnkd.in/d8CHDZtE)
- Alexandra Ene (https://lnkd.in/dseMXfd4)
- Anabella Cotovanu (https://lnkd.in/dn2y2mrv)
- Discussion & closing (https://lnkd.in/dhrbrNHr)

Once again our warmest thanks to Professor Loretta Batali, President of the Romanian Geotechnical Society, and her team for their impeccable organisation and hospitality, our Secretary General Giorgos Belokas thanks to whose efforts and networking we started our official contacts with the Romanian Geotechnical Society, culminating in this superb first seminar, of course all our speakers, and as always our colleague Dimitris Tsoutsas who handles our youtube channel!

Stay tuned for the 2nd Greece-Romania Seminar to be held in Greece soon!

ΕΛΛΗΝΙΚΗ
ΕΠΙΤΡΟΠΗ
ΣΗΡΑΓΓΩΝ ΚΑΙ
ΥΠΟΓΕΙΩΝ ΕΡΓΩΝ

https://www.eesye.gr

Η ιστοσελίδα της Ελληνικής Επιτροπής Σηράγγων και Υπογείων Έργων (ΕΕΣΥΕ) www.eesye.gr αποτελεί την επίσημη ψηφιακή πύλη ενημέρωσης για τις δραστηριότητες και το έργο της Επιτροπής στον τομέα των σηράγγων και υπόγειων κατασκευών. Ο ιστότοπος προσφέρει πρόσβαση σε θεματικές ενότητες όπως νέα και ανακοινώσεις, εκδηλώσεις και δράσεις αλλά και πληροφορίες για την ιστορία, τα μέλη και τη διοίκηση της ΕΕΣΥΕ.

Η ΕΕΣΥΕ, ως επιστημονικό μη κερδοσκοπικό σωματείο, προωθεί τη χρήση των σηράγγων και υπογείων έργων αλλά και τη γνώση και την καινοτομία σε θέματα σχεδιασμού, κατασκευής και λειτουργίας τέτοιων έργων. Έχει συνεπώς οργανώσει μια πληθώρα δράσεων για τα μέλη της και τον τεχνικό κόσμο της χώρας που περιλαμβάνει διοργάνωση συνεδρίων και ημερίδων ενημέρωσης, εκπαιδευτικών και επιμορφωτικών σεμιναρίων, καθώς και εκδρομών σε έργα που βρίσκονται υπό κατασκευή. Στον ανανεωμένο ιστότοπο της μπορείτε να ενημερωθείτε για τις τελευταίες εξελίξεις και επόμενες δράσεις της Επιτροπής, να βρείτε διαθέσιμο όλο το υλικό από τις δράσεις της ΕΕΣΥΕ (πρακτικά συνεδρίων, άρθρα, video από προσκεκλημένες ομιλίες, τα αρχεία του περιοδικού της ΕΕΣΥΕ, κ.α.), να δείτε την ελληνική παρουσία στην Παγκόσμια Ένωση Σηράγγων (ITA-AITES) αλλά και να επικοινωνήσετε με την Επιτροπή για ότι θελήσετε. Τέλος, σημαντικό στοιχείο του ιστοτόπου είναι τα στοιχεία καταγραφής των ελληνικών σηράγγων και υπόγειων έργων, από την αρχική καταγραφή τους από μέλη της ΕΕΣΥΕ πριν περίπου 25 χρόνια, μέχρι τον πλέον πρόσφατο διαδραστικό χάρτη που παρουσιάζει τα έργα σηράγγων και υπογείων κατασκευών που αναπτύσσονται σε όλο τον Ελλαδικό χώρο.

SIMSG ISSMGE

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News

www.issmge.org/news

Proceedings from the 17th Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVII PCSMGE) available in open access

ISSMGE IT Administrator / General / 13-05-2025

ISSMGE is pleased to announce that through the initiative of the Organizing Committee of PANAMGEO Chile 2024, the papers from the proceedings of the 17th Pan-American Conference on Soil Mechanics and Geotechnical Engineering (XVII PCSMGE) are available in the online library: https://www.issmge.org/publications/online-library

The conference took place in La Serena, Chile, between 12-16 November 2024.

Detailed acknowledgements for the XVII PCSMGE can be found at the ISSMGE online library acknowledgements section.

ISSMGE Interactive Technical Talk Episode 24: Foundation Engineering for Difficult Soft Soil Conditions (TC214)

ISSMGE IT Administrator / TC214 / 19-05-2025

The twenty-fourth episode of International Interactive Technical Talk has just been launched and is supported by TC214. Yoichi Watabe, Minna Karstunen, Suched Likitlersuang and Thomas Becket Anyintuo are discussing with Marc Ballouz about "Foundation Engineering for Difficult Soft Soil Conditions". https://www.issmge.org/education/interactive-technical-talks

Meet Our Young Member Groups Around the World! – Brazil (ABMS)

Max Barbosa / Young Members / 21-05-2025

The **Young Members Presidential Group (YMPG)** proudly launches the first video in its global spotlight series:

Meet Our Young Member Groups Around the World! starting with the dynamic **Brazilian Geotechnical Society (ABMS)**.

In this debut video, we dive into the energy and creativity of ABMS's young members, showcasing how theyve built a thriving national network through regional events, technical webinars, student engagement, and participation in major congresses like COBRAMSEG.

With representatives in all Brazilian regions, the ABMS Young Members have been instrumental in:

- Promoting **academic-industry connection**
- Encouraging student participation and mentoring
- Hosting **technical challenges, geotechnical talks, and site visits**
- And contributing actively to the international geotechnical dialogue

Watch the video to see how passion, teamwork, and innovation have made ABMSs young group a model for engagement and a powerful voice in Brazils geotechnical future.

We would love to hear from you!
To contact us, please send emails to:
ympg.issmge@gmail.com

Let's build a connected, visible, and inspiring future one young group at a time.

GeoEngineers Without Borders (GeoWB): Expanding Global Impact in Geodisaster Response

ISSMGE IT Administrator / General / 27-05-2025

GeoEngineers Without Borders (GeoWB) continues to strengthen its role in international geodisaster response, leveraging a global network of Geoengineers to support vulnerable communities and enhance geotechnical resilience. The establishment of GeoWB is progressing steadily, driven by the commitment of its members and the importance of personal connections in fostering collaboration.

Global Missions and Field Actions

GeoWB has successfully conducted several field missions, engaging outstanding engineers from various regions:

- **Papua New Guinea** Led by Ian Kupec (New Zealand)
- **Rio Grande do Sul, Brazil** Led by Gabriela Mederos (Brasil/UK) and Fernando Marinho (Brasil)
- **Derna Dams, Libya** Led by Ahmed Chraibi (Morocco)
- **Mission in La Paz, Bolivia** Led by Fernando Marinho (Brasil) and Bernardo Caicedo (Colombia) invited by Durval Párraga (Bolivia)

These initiatives exemplify GeoWBs commitment to applying geotechnical knowledge to mitigate disaster risks and enhance resilience worldwide.

ISSMGE Support and Future Directions

The ISSMGE has played a crucial role in supporting GeoWBs development and expansion. Key upcoming engagements include:

- A **plenary session at the ISSMGE conference in Vienna**, aimed at informing and motivating the next ISSMGE President to further strengthen the initiative.
- Additional **plenary sessions in Regional Conferences**, promoting GeoWBs actions across different regions.

La Paz, Bolivia

Join the Movement

GeoWB invites geotechnical professionals, researchers, and organizations to engage with its ongoing initiatives and contribute to its expanding impact. For more information, explore:

- GeoWB Official Page
- GeoWB Reports on Geodisaster Response

Stay tuned for upcoming activities, and let's continue working together to build a more resilient and connected geotechnical community.

☙ ❧

International Society for Rock Mechanics and Rock Engineering

ISRM

News

https://www.isrm.net

Eurock 2025 - Welcoming you in Norway, June 16-20! 2025-05-16

Dear ISRM colleagues,

Exciting news! EUROCK 2025 is fast approaching, and you can still secure your participation in this upcoming event. Head over to our registration page at https://eurock2025.com/registration to secure your spot today!

We still have some Sponsorship and Exhibitor opportunities available. This is your chance to showcase your products and services to a global audience of leading rock mechanics and rock engineering professionals. Visit our website to find out how you can get involved: https://eurock2025.com/sponsors-and-exhibitors

We already have participation from renowned companies such as Geobrugg AG, ITASCA, Kajima Corporation, MACCAFERRI, New Zealand Geotechnical Society, NGI, Stress Measurement Company Oy, Tre Altamira, and Multiconsult.

For detailed information on registration, workshops, tours, and everything related to EUROCK 2025, please visit our website at www.eurock2025.com.

We look forward to welcoming you to Trondheim, Norway, from June 16-20, 2025!

Best regards,

The EUROCK 2025 Organizing Committee

49th ISRM Online Lecture by Prof. Robert Zimmerman on 5 June 2025-05-16

The 49th ISRM Online Lecture will be given by Professor Robert Zimmerman, from Imperial College London, UK. The title of his lecture will be "Fluid Flow in Fractured Rocks". It will be broadcast on 5 June and will remain available on the online lectures dedicated webpage.

☙ ❧

ASSOCIATION INTERNATIONALE DES TUNNELS ET DE L'ESPACE SOUTERRAIN AITES | ITA INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION

News

https://about.ita-aites.org/news

ITA Executive Council launches new meeting plan and hosting initiative 14 May 2025

President Andrea Pigorini greets Hamdi Aydin, the delegate from Türkiye to the General Assembly in Stockholm. (Photo: ITA)

The ITA Executive Council (ExCo) has released its official meeting schedule through to the ITA World Tunnel Congress (WTC) 2028, marking a significant step in long-term planning and international engagement. The newly published meeting plan outlines a comprehensive calendar of in-person and virtual meetings, including key sessions aligned with the WTC and ITA Awards.

In a notable development, ExCo is introducing a new practice inviting Member Nations to express interest in hosting ExCo meetings that do not coincide with the WTC or ITA Awards. This initiative aims to foster broader participation and visibility across the global tunnelling community.

— This long-term planning is not just about coordination—it is about giving structure and predictability to our work as a Council. It allows us to better prepare, engage more deeply with Member Nations, and ensure continuity in our strategic goals, states Andrea Pigorini, President of ITA.

Member Nations interested in hosting are encouraged to submit a short letter of intent to the ITA Secretariat. Hosts may also organise a conference or symposium around the ExCo meeting dates—typically just before or after the weekend. In such cases, ExCo members may support the event by delivering presentations or keynote speeches, with the ITA President traditionally addressing the opening ceremony. Presentations on specific topics may also be provided by ExCo members upon request.

— With this new practice, we hope to strengthen the connection between ExCo and the broader ITA community. It offers Member Nations a unique opportunity to showcase local achievements and engage directly with ExCo members on strategic topics, Pigorini is adding.

Upcoming ExCo Meeting Opportunities for Hosting (2026–2028)

- **7–8 March 2026** – Physical meeting (open call to host)
- **27–28 June, 4–5 July or 11–12 July 2026** – Physical meeting (open call to host)
- **29–30 August, 5–6 September or 12–13 September 2026** – Physical meeting (open call to host)
- **30–31 January, 6–7 February or 13–14 February 2027** – Physical meeting (open call to host)
- **19–20 June, 26–27 June or 3–4 July 2027** – Physical meeting (open call to host)
- **28–29 August, 4–5 September or 11–12 September 2027** – Physical meeting (open call to host)
- **29–30 January, 5–6 February or 12–13 February 2028** – Physical meeting (open call to host)

For further details or to express interest in hosting, Member Nations should contact the ITA Secretariat.

Scooped by ITA-AITES #133, 27 April 2025

Work begins on Madrid airport metro extension | Spain

WTC 2026 Montreal abstract submission deadline set | Canada

How Many Tunnels Are There Under The Thames? | UK

An Underground Lab in South Dakota Could be Key in Advancing Geothermal Energy | USA

Renovation of the Simplon Tunnel: Construction Work Starts in February 2025 - Switzerland

New Tunnel Will Connect NYC to Hoboken and Jersey City | USA

Manipur Enhance Northeast Railway Network with Sangaihel Tunnel Featuring Innovative Dual-Tunnel System Allowing Safe Passage and Dedicated Emergency Evacuation | India

Major construction begins on Suburban Rail Loop | Australia

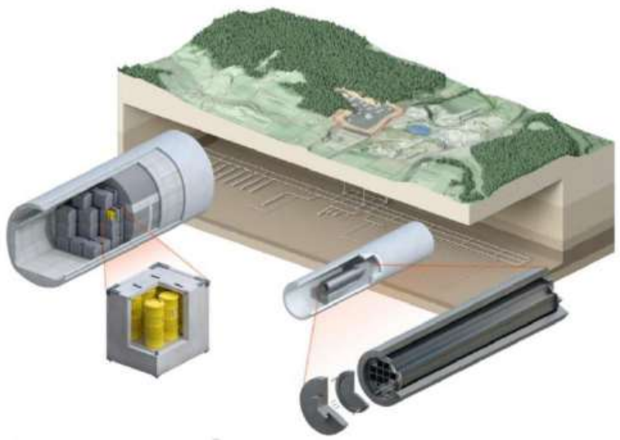
Italian Section of Brenner Base Tunnel Hits Completion Milestone

The incredible £6.2bn underwater tunnel set to become the world's longest | Denmark - Germany

BTSYM Special Lecture

The Deep Geological Repository in Switzerland – Critical Engineering Challenges

Thursday, 1 May 2025, 12:15 - 13:45 (GMT+1)
Seminar Room, Civil Engineering Building, University of Cambridge , 7a JJ Thomson Avenue, Cambridge CB3 0FA
Format: In-person & Online (registration https://lnkd.in/ekZ4r2Jt)



Nuclear energy plays a central role in the decarbonisation pathway towards net zero, providing a reliable and scalable source of electricity with virtually no direct emissions. Nevertheless, its widespread deployment poses significant challenges, foremost among them being the safe, long-term management of radioactive nuclear waste. The concept of deep geological disposal originated in the 1960s and has since evolved into an internationally recognised solution for long-term waste containment. It entails isolating the waste from the human habitat by emplacing it in repositories embedded in stable geological formations several hundred metres below the ground surface. The repository's safety over the thousands of years required for radioactive decay relies on a multi-barrier system, comprising engineered barriers as well as the host rock, which acts as a natural barrier. Deep geological repository initiatives are currently advancing at varying levels of technical and regulatory maturity in many countries across the globe.

In Switzerland, the construction of a deep geological repository is foreseen over the next years. Nagra – the Swiss National Cooperative for the Disposal of Radioactive Waste – has identified Opalinus Clay as the most suitable host rock, due to its favourable properties for long-term waste containment: extremely low hydraulic permeability, self-sealing capacity via swelling, and waste radionuclide retention capacity. Since 2008, intensive geological investigations have been conducted to identify the most suitable siting region for the repository. These efforts culminated in Nagra's 2024 siting proposal for Nördlich Lägern, a site in northern Switzerland offering an optimal combination of depth (ca. 900 m), thickness (ca. 100 m), and lateral extent of the Opalinus Clay formation. At Nördlich Lägern, a combined repository is currently planned, encompassing 3.5 m-diameter emplacement drifts for high-level waste (HLW), and 14 m-diameter emplacement caverns for low- and intermediate level waste (L/ILW).

The design and construction of the repository's underground structures pose significant technical challenges, inter alia due to the substantial depth, the prevailing hydrogeological conditions, and the geomechanical behaviour of the host rock. This presentation delves into some critical engineering challenges addressed over the past years, including: (i) the comprehensive geotechnical characterisation of Opalinus Clay based on an extensive suite of laboratory experimental investigations; (ii) the development of a design-oriented constitutive modelling framework for Opalinus Clay, capable of reproducing intricate aspects of its hydromechanical behaveiour and accounting for key uncertainties; and (iii) the development of high-fidelity computational models for the assessment of hazards related to the construction and long-term structural safety of the emplacement tunnels, considering their intended purpose. The presented advancements highlight critical design considerations for the subsequent project stages, but also reveal novel aspects and offer broader guidance for the development of underground infrastructure in comparably demanding environments.

Speaker

Dr. Alexandros Nordas is a Senior Scientific Associate and Lecturer in the Chair of Underground Construction at ETH Zurich. His research focuses on life-cycle simulation and hazard assessment of underground systems, squeezing ground conditions and related time-dependent processes (creep, consolidation), mechanised TBM tunnelling, constitutive modelling, as well as the development of design aids for engineering practice. Over the past years, Alexandros has also been actively involved as an expert technical consultant in underground infrastructure projects, predominantly the deep geological repository for radioactive waste in Switzerland overseen by Nagra. Since September 2024, he has also undertaken the position of Senior Specialist for Rock Mechanics and Underground Construction at Nagra, alongside his position at ETH Zurich.

Alexandros holds a 5-year Diploma in Civil Engineering from the National Technical University of Athens (2013; Honours), along with an M.Sc. in Earthquake Engineering (2014; Distinction) and a Ph.D. in Computational Structural Mechanics (2019) from Imperial College London. He has authored and co-authored more than 40 expert technical consulting reports and scientific publications in international, peer-reviewed journals and conference proceedings. He also serves as a peer reviewer for the Journal of Rock Mechanics and Geotechnical Engineering (Elsevier), Rock Mechanics and Rock Engineering (Springer), and several others. Throughout the years, Alexandros has received numerous honours and awards in recognition of his work and teaching, including the Telford Premium Prize by the Institution of Civil Engineers (ICE), as well as the Letitia Chitty Centenary Memorial Prize and the Patrick J. Dowling Prize in Advanced Structural Engineering from Imperial College London.

Join us for a fascinating seminar exploring the technical challenges behind Switzerland's deep geological repository for nuclear waste, including advanced modelling techniques and underground construction at depth. For more information on the abstract and the speaker's biography, please refer to the poster below.

This event is organized by the EPSRC Centre for Doctoral Training in Future Infrastructure and Built Environment: Resilience in a Changing World (FIBE2).

For any enquiries, please email hhy26@cam.ac.uk

BTSYM May Workshop

Connecting the dots - a tunnel engineering knowledge framework

Thursday, 15 May 2025, 13:30 - 17:30 (GMT+1)
[in person] ICE HQ, One Great George Street, London, SW1P 3AA

Event Information:

Drawing upon his 15+ years experience combining structural and geotechnical engineering, Si Shen will offer you a free-style workshop that helps you establish a knowledge framework for tunnelling, connecting your existing and new nodes of knowledge together in a structured manner. This workshop:

- Is oriented towards young members and students, but old friends can also have new discoveries
- Combines structural engineering and geotechnical engineering knowledge
- Connects analysis, management and construction practices
- Will be free from equations. Only common sense is needed
- Is suitable for practicing engineers from contractors, clients and consultancies
- Is more about tunnelling in soil than that in rock

This is a crash course for all matters tunnelling, including:

- Forms of construction for tunnels, cross passages, shafts and portals, and why they are chosen
- Structural behaviours of underground structures, and the specific considerations for each type
- Characteristics of different types of ground conditions and what to do about each
- Analysis methods of ground-structure interactions
- Water resistance, different ways of achieving it
- Delivery, coordination and other management matters, and how these are interwoven into the technicals
- Most importantly, this workshop connects discrete nodes of knowledge to build up a big picture. This macro level framework gears you up towards delving into any specific field of practice in the world of tunnelling.

Originally designed as an internal TYPSA workshop, it's now open to the public — an opportunity you won't want to miss!

Speaker

Si Shen (Head of Tunnelling and Geotechnics department, TYPSA UK) Si Shen is a chartered engineer with 15+ years' design experience on mega tunnelling projects including HS2, Thames Tideway, Crossrail and Brisbane Cross River Rail, providing technical and team leadership for delivering holistic designs providing technical and team leadership for delivering holistic designs combining geotechnics and structures for tunnels and underground works in general. His technical experience spans from deep mined tunnels (TBM-built, sprayed concrete lined) to shallow tunnels (cut-and-cover) and deep vertical excavations (shafts/station boxes), with particular strength in the analysis of soil-structure interaction and water resistance of underground works.

INTERNATIONAL GEOSYNTHETICS SOCIETY

www.geosyntheticssociety.org

News

Did You Know? An independent evaluation shows geotextiles are the most sustainable option for embankment protection filters May 6, 2025

Did You Know?… synthetic geotextile filters cost 1.5 times less than granular filters + three to eight times less than using natural fibre materials In **Read More »**

IGS Brazil Marks Busy Year Of Sustainability Initiatives May 7, 2025

IGS Brazil has shared the progress it made last year in its efforts to nurture and inspire greater sustainability practices in the industry. Its Sustainability **Read More »**

IGS Launches Survey To Better Understand Its Members May 12, 2025

IGS members will soon receive an email inviting them to respond to a survey. Led by the IGS's Diversity Committee (DC), the questionnaire is designed **Read More »**

Sustainability Calculator Videos Launched Following Kentucky Conference May 19, 2025

The first instructive videos on using the IGS Environmental Sustainability Calculator are now available. Four recordings are now ready to view on the IGS website **Read More »**

Success For IGS Romania's GeoSint Conference May 27, 2025

IGS Romania's first GeoSint conference for 18 years attracted nearly 200 participants from 18 countries. Coinciding with the Chapter's 35-year anniversary, the 4th Romanian Conference **Read More »**

BGA · THE BRITISH · GEOTECHNICAL ASSOCIATION

News

https://www.britishgeotech.org/news

Professor David Potts to give a Special Lecture at Earthworks 2025 Conference 02.05.2025

The BGA is pleased to announce that Dave Potts will give a Special Lecture at our Earthworks 2025 Conference in September. Read More

Registration is now open for Earthworks 2025 Conference 02.05.2025 Read More

Voting for Election to BGA Executive Committee – Deadline 30 May 2025 02.05.2025

The election to select three candidates to the British Geotechnical Association (BGA) Executive Committee is now in progress – Deadline 30 May 2025 Read More

The June 2025 issue of Ground Engineering is available on line 15.05.2025

The June 2025 issue of Ground Engineering is available on line. Online access to Ground Engineering (GE) is included in BGA subscriptions. Read More

Call for abstracts for the 12th International Conference on Bearing Capacity of Roads, Railways, and Airfields (BCRRA 2026) 19.05.2025

Call for abstracts for the 12th International Conference on Bearing Capacity of Roads, Railways, and Airfields (BCRRA 2026). The deadline for submissions is 9 June 2025. Read More

Notice and Agenda for The BGA Annual General Meeting, 25 June 2025 25.05.2025 Read More

G-I ASCE GEO-INSTITUTE

News

www.geoinstitute.org/news

Diggs code jam 2025 progress pitfalls and path forward

Created: 09 May 2025

Scott L Deaton, Ph.D., President, Dataforensics

The 2025 DIGGS Code Jam brought together vendors and developers across the geotechnical data management space to put the DIGGS (Data Interchange for Geotechnical and Geoenvironmental Specialists) schema to the test — and the results were both encouraging and eye-opening. The DIGGS Code Jam was the first time multiple vendors attempted to import the most comprehensive DIGGS file produced to date. The file included over 8,000 pieces of data from multiple boreholes with well construction details and laboratory test data. The challenge specified that vendors should import the example file provided by the DIGGS committee and then produce a variety of outputs based on the data. Potential reports could include borehole logs, particle size distribution reports, Atterberg Limits report, tabular summary of lab data, and sitemaps. …

Jazz age geotechnical engineering part 6 case study St. Francis Dam failure

Created: 16 May 2025

Review of *Foundations, Abutments and Footings* (Hool and Kinne, Eds., 1923), *Sections 5 (Underpinning) and 6 (Foundations requiring special consideration)*, featuring the St. Francis Dam as a case study

By Michael Bennett, P.E. (GFT: Audubon, PA)

The St. Francis Dam breach on March 12th, 1928, drowned over 450 victims. The plentiful paper trail left by the disaster has led over the subsequent century to many follow-up studies of it utilizing more modern geotechnical analyses. Thus, a consensus (never a given in historical studies) exists around what happened geotechnically at the scene of the St. Francis breach. Engineer William Mulholland, legendary designer of the Los Angeles Aqueduct, selected a site in the St. Francis Canyon about 40 miles northeast of the City of Angels for a reservoir to expand the city's water supply. Yet he never considered the site's engineering geology and thus overlooked a fragile, fracture-prone mica schist formation and a dormant paleo-landslide at the proposed structure's east abutment along with a friable sandstone formation along its proposed west abutment. As design progressed, Mulholland failed to incorporate adequate measures for uplift mitigation into his dam. During construction, he increased its height without also widening its base. The dam initially functioned well after its opening in 1926, but heavy rains in early 1928, kept the reservoir just inches below the dam's crest for weeks. Permeation through the fissile mica schist beneath the east abutment and the dam itself thus increased per Darcy's Law, and locals began noticing (Hundley and Jackson 2015, Rogers 1995). (σ.σ. παρουσιάζεται ολόκληρο το άρθρο στην σχετική ενότητα).

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΤΕΧΝΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

ISRM International Society for Rock Mechanics and Rock Engineering

Η ISRM απένειμε το βραβείο Franklin Lecture Award στον Χάρη Σαρόγλου

The **International Society for Rock Mechanics and Rock Engineering (ISRM)** has awarded our member Dr. **Harry Saroglou** with the Franklin Lecture Award for his significant contribution to Rock Mechanics. The award was presented by ISRM President Seokwon Jeon during the opening ceremony of the Eurock 2025 conference in Trondheim, Norway. Mr. Saroglou presented the lecture titled "Engineering in Anisotropic Rock Masses". A summary of the lecture will be published in the ISRM News Journal.

The Franklin Lecture Award was established in 2011 by the ISRM Council in memory of John Franklin, former President of the International Society for Rock Mechanics (ISRM) from 1987 to 1991.

The award is established to recognize a member of the International Society for Rock Mechanics, in the middle of his/her professional career, for his/her significant contribution to Rock Mechanics. More about the award on the ISRM website **https://lnkd.in/dMNCzXPJ**

Our warmest congratulations to our member on this very important distinction!

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

DTU TC101 workshop Expanding the boundaries of conventional laboratory testing, 2nd-4th June 2025, Copenhagen, Denmark, www.conferencemanager.dk/expandingtheboundariesofconventionallaboratorytesting

2nd International Symposium on GeoTest Sites (2nd ISGTS), 5-6 June 2025, Tampere, Finland https://events.tuni.fi/isgts

ISFOG 2025 5th International Symposium on Frontiers in Offshore Geotechnics, June 9-13, 2025, Nantes, France, https://isfog2025.univ-gustave-eiffel.fr

GeoAsia - 8th Asian Conference on Geosynthetics, 10-13 June 2025, Brisbane, Australia, https://geoasia8.org

EGRWSE-2025 6th International Conference on Environmental Geotechnology, Recycled Waste Materials and Sustainable Engineering, June 11-14, 2025, Vigo, Spain, https://egrwse2025.webs.uvigo.es/

EUROCK 2025 - ISRM European Rock Mechanics Symposium Expanding the underground space - future development of the subsurface - an ISRM Regional Symposium, 16-20 June 2025, Trondheim, Norway, https://eurock2025.com

3rd International Conference on Energy Geotechnics – Implementing the Energy Transition, 17-20 June 2025, Paris, France, Kamelia Atefi-Monfared, catefi@yorku.ca

The Fourth Pan-American Conference on Unsaturated Soils, June 22 - 25, 2025, Ottawa, Ontario, Canada www.panam-unsat2025.ca

5ICGE & 3ICESE 5th International Conference on Geotechnical Engineering-Iraq & 3rd International Conference on Engineering Science & Energy, 1–3 July 2025, 3 July 2025, Komar University, Sulymaniyah, Iraq, Saint-Petersburg, Russia, https://icge.tech

6th International Conference GEE2025: Charting the path toward the future Geotechnical Engineering Education, July 2-4 2025, Nancy, France, https://gee2025.sciencesconf.org/

AFRICA 2025 The Fifth International Conference and Exhibition on Water Storage and Hydropower Development for Africa, 8-10 July 2025, Accra, Ghana www.hydropower-dams.com

ISGSR2025 9th International Symposium for Geotechnical Safety and Risk, 24th – 27th August 2025, Oslo, Norway, www.isgsr2025.com

Giz2025.org 6th International Conference on GIS and Geoinformation Zoning for Disaster Mitigation (GIZ), August 28-30, Almaty, Kazakhstan, https://giz2025.org

On-site Short Course on Geotechnical Earthquake Engineering, 30 August – 7 September, Kobe and Tokyo, Japan, ixa@ethz.ch

UNSAT2025 5th European Conference on Unsaturated Soils, 1 to 3 September 2025, Lisbon, Portugal, https://eunsat2025.tecnico.ulisboa.pt

ISP8 Symposium International pour le 70ème anniversaire du pressiomètre / International Symposium for the 70th Anniversary of the Pressuremeter, 2nd to 5th of September 2025, LUXEMBOURG, https://isp8-pressio2025.com

TKZ2025 XXI Technical Dam Control International Conference, 09-12 September 2025, Chorzów, Poland https://tkz.is.pw.edu.pl/en/

EYGEC 29th European Young Geotechnical Engineers Conference, 9-12 September, 2025, Rijeka, Croatia, https://eygec2025.uniri.hr

EUROGEO Technical Challenges and Environmental Imperatives for the 21st Century, 15-18 September 2025, Lille, France, https://eurogeo8.org

TRANSOILCOLD 2025 7th International Symposium on Transportation Soil Engineering in Cold Regions, September 17-20, 2025, Incheon, Korea, www.transoilcold2025.org

2025 AIGTAS IWLSC 3rd International Workshop on Landslides in Sensitive Clays, September 28th to October 2nd, 2025, Quebec, Canada www.iwlsc2025.ca

GROUND ENGINEERING GEOTECH 2925 Where innovation meets opportunity, 2 October 2025, London, United Kingdom https://www.geplus.co.uk/news/ground-engineering-to-launch-geotech-2025-conference-where-innovation-meets-opportunity-16-01-2025

GEOTECH ASIA 2025 - GEOVADIS: The Future of Geotechnical Engineering, October 7th to 10th, 2025, Goa, India, https://www.geotechasia.org

*f*OMLIG3 FLORENCE 2025 Third Workshop on the Future of Machine Learning in Geotechnics "Ethics and intelligences for a geotechnical Renaissance", October 15-17, 2025, Florence, Italy https://fomlig2025.com

Urban GeoEngineering 5th AsRTC6 "Urban GeoEngineering" Symposium, 23rd & 24th of October 2025, Taipei, Taiwan, www.asrtc6urbangeoengineering2025.com/index.html

6ο Πανελλήνιο Συνέδριο Αντισεισμικής Μηχανικής και Τεχνικής Σεισμολογίας (*6ΠΣΑΜΤΣ*), 30, 31 Οκτωβρίου και 1 Νοεμβρίου 2025, https://6psamts.eltam.org

Med-GU-25 5th Annual Meeting Mediterranean Geosciences Union, 10–13 November 2025 in Athens, Greece, https://2025.medgu.org/index.php

7ο Συνέδριο Αναστηλώσεων, 13-15 Νοεμβρίου 2025, Αθήνα, www.etepam.gr/7o-synedrio-anastiloseon

ORFEUS+EFEHR+EMSC (EPOS Seismology) & Geo-INQUIRE Workshop 2025, 24-27 November 2025, Athens, Greece, https://www.geo-inquire.eu/about/terms-and-conditions, https://docs.google.com/forms/d/e/1FAIpQLSf-LXXy8X-jiEtaCaI_n2VIp7QcM-71TJAY9ZCsPlt8SVNM1Q/viewform

17th International Conference on Geotechnical Engineering 8th International Symposium on Geohazards, December 4-5, 2025, Lahore, Pakistan, https://17icge-8isg.com

PMGEC LEBANON 2026 Pan Mediterranean Geotechnical Engineering Conference, 25 - 28 March 2026, Phoenicia Beirut IHG, Lebanon https://pmgec-leb.com

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International Conference on Geotechnics, Civil Engineering and Structures (CIGOS) 2026 Innovation in Planning, Design and Civil Infrastructure for Resilient and Sustainable Transformation

April 16 & 17, 2026, Ho Chi Minh City, Vietnam
https://cigos2026.sciencesconf.org

Since its beginning in 2010 in Paris, the International Conference on Geotechnics, Civil Engineering and Structures (CIGOS) has solidified its reputation as a prominent global forum for fostering high-quality academic and professional exchanges in geotechnical, structural, and construction engineering. With seven successful editions, CIGOS continues to attract a diverse community of academics, researchers, designers, policymakers, and entrepreneurs to share cutting-edge advancements and innovative ideas.

The 8th edition, CIGOS 2026, will be co-organized by the Association of Vietnamese Scientists and Experts (AVSE Global), the University of Architecture Ho Chi Minh City (UAH) and the University of Sydney Vietnam Institute (SVI), under the auspices of ISSMGE TC-309. The conference is scheduled to take place in **Ho Chi Minh City, Vietnam** on **April 16 & 17, 2026**, under the theme **"Innovation in Planning, Design and Civil Infrastructure for Resilient and Sustainable Transformation"**.

CIGOS 2026 aims to address global challenges in creating resilient and sustainable infrastructure through innovation and interdisciplinary collaboration. The conference welcomes submissions from worldwide researchers, practitioners, and industry leaders. The key objectives of CIGOS 2026 are to:

- Provide a platform for sharing knowledge, experiences, and recent advancements in civil engineering and related fields.
- Foster economic partnerships and technological transfers among enterprises and institutions.
- Strengthen international cooperation in research, education, and sustainable development.

The conference will cover a range of topics, including, but not limited to:

- *Artificial Intelligence, Data Analytics, Digital Transformation*
- *Construction, Materials, Structures, Digital Technologies*
- *Geosciences, Environment, Energy*
- *Planning, Architecture, Industrial Design*
- *Transportation, Infrastructure, Management and Investment*

For more information, please contact: secretariat@cigos.org

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LANDSLIDES 2026 Landslide Geo-Education and Risk (LaGER), 27 April - 1 May 2026, Queenstown, New Zealand http://landsliderisk.nz

15th International Conference "Modern Building Materials, Structures and Techniques", May 12-15, 2026, Vilnius, Lithuania, https://vilniustech.lt/332107

ITA-AITES WTC 2026 World Tunnel Congress, May 15 to 21, 2026, in Montreal, Quebec, Canada, https://wtc2026.ca

ICPMG 2026 Physical Modelling in Geotechnics 8–12 June 2026, ETH Zürich, Switzerland, https://tc104-issmge.com/icpmg-2026

8th International Young Geotechnical Engineers Conference - 8iYGEC, 11. - 14. June 2026, Graz, Austria, www.tugraz.at/institute/ibg/events/8iygec

21st International Conference on Soil Mechanics and Geotechnical Engineering Geotechnical Challenges in a Changing Environment, 14 – 19 June 2026, Vienna, Austria, www.icsmge2026.org/en

3rd International Geotechnical Innovation Conference - Shaping the World Beneath: Fostering Sustainability, Innovation and Resilience in Geotechnics, 15 - 16 June 2026, Jeddah, Saudi Arabia, https://geotechnicalinnovationconference.com Email info@creativeconnectionevents.com

৫ ৯

International Conference on Natural Hazards & Infrastructure

29 June – 2 July 2026, Chania, Greece
https://iconhic.com/2026

ICONHIC2026 aims to be a catalyst for change in how we build resilient infrastructure in a world shaped by climate extremes, economic volatility, and systemic risk. Through high-level dialogue, cross-sector collaboration, and curated innovation showcases, it will explore how to design, finance, and govern infrastructure in an age of uncertainty — turning disruption into opportunity.

From **29 June to 2 July 2026**, in Chania, Greece — a city offering a stunning backdrop of history, culture, and natural beauty — leaders in engineering, policy, finance, technology, and research will come together to challenge assumptions, share solutions, and shape a future-ready agenda.

About the Conference

Over the past decade, ICONHIC has been established as a leading international forum for advancing resilience across infrastructure systems, cities, and communities, promoting the collaboration and synergies needed to address challenges at the intersection of climate risk, technological innovation, and sustainable development.

The technical program is structured around seven thematic streams, bridging the full spectrum of resilience — from hazard source, to infrastructure impact, to community disruptions — along with a series of expert-led special sessions, all designed to promote dialogue, challenge silos, and foster interdisciplinary thinking.

From high-level plenaries to themed sessions and live demonstrations, content is shaped from the ground up by a diverse Steering Committee and an open call for contributions. Participants are encouraged to explore session formats that go beyond traditional presentations to enable genuine exchange and engagement.

Seven Thematic Streams

Bridging the Disciplines of Resilience

Climate, Natural Hazards, and Disasters

– Climate models and predictive analytics
– Flood hazard: assessment and mitigation
– Extreme wind and severe storms
– Wildfire risk in an evolving landscape
– Extreme heat and droughts
– Coastal hazards and sea-level rise
– Permafrost, the Arctic, and cold regions
– Glacier outbursts and avalanches
– Volcanic hazards
– Earthquakes and seismic hazard assessment
– Hazards cascades, tsunamis, and landslides
– Infrastructure in multi-hazard environments

System-Approach to Risk and Resilience Assessment

– Interconnected systems: transportation, energy, water, ICT, and lifelines
– Business interruption & recovery of infrastructure
– Public preparedness and recovery strategies
– Ageing Infrastructure and lifecycle modelling
– Stress testing of critical infrastructure systems
– Data-Poor Environments: Risk analysis strategies
– Threat-agnostic resilience frameworks

Urban Adaptation & Sustainability

– Decarbonizing infrastructure
– Nature-based solutions for climate resilience
– Climate-tech innovations
– Infrastructure circularity and resource efficiency
– Rebuilding after disaster: Ukraine, Myanmar, and beyond
– Community-led planning and engagement for cities

People, Policy & Governance for Resilience

– Participatory planning & co-design of infrastructure
– Socially inclusive resilience strategies
– Communicating risk to communities & policymakers
– Collaboration for adaptive governance

Insurance & Cat Modeling

– Insurance as a catalyst for resilience
– Cat modeling: Challenges and advancements
– Big data and remote sensing
– Innovative insurance solutions for climate
– Climate change: Decision making under uncertainty

Financing Resilience

– Private-Public Participation for sustainable resilient infrastructure
– De-Risking climate investments
– Economic benefits of resilience: Tools & methods
– Climate investments in EMDEs: Challenges & opportunities

Technologies for Resilience Management

– Early warning systems for disaster resilience
– Remote sensing for resilient development
– Monitoring and diagnostics for lifecycle resilience and predictive maintenance
– Predict, prevent & manage catastrophe loss with AI-powered analytics
– Advances in digital twins and sensors
– Digitalization of integrity management
– Seismic isolation and retrofit

Email secretary@iconhic.com

ΟΣ ΧΟ

ISFMG 2026 12th International Symposium on Field Monitoring in Geomechanics, 06 -10 August 2026, Indian Institute of Technology Indore, India, https://sites.google.com/view/isfmg2026/home

ΟΣ ΧΟ

International Conference on

Advances and Innovations in Soft Soil Engineering 2026

24-26 August 2026, Delft, Netherlands

As global land development expands into coastal regions, offshore reclamation areas, and wetlands, the geotechnical challenges posed by soft soils are becoming more critical. These soils, including highly sensitive clays, marine silty clays, organic soils, peats, loose sands, and dredged soils, are known for their high compressibility, water content, and complex mechanical properties, making construction projects in such areas problematic. To address these challenges, soft soil engineering is evolving with innovative technologies and approaches.

This conference, organised under the auspices of the ISSMGE Technical Committee 214 on "Foundation Engineering for Difficult Soft Soil Conditions", will showcase the latest developments in testing, modelling, monitoring and construction and improvement techniques for soft soils. It will provide a platform for researchers, engineers, and industry professionals to exchange expertise and discuss how these innovations can be applied to address modern construction challenges in soft soil environments.

Contact Information

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ΟΣ ΧΟ

X Latin American Congress on Rock Mechanics 26 - 28 Aug, 2026, Brsasilia, Brazil

Contact Person: Marcos Massao Futai, Brazilian Committee of Rock Mechanics

☙ ❧

13 ICG - 13th International Conference on Geosynthetics (13 ICG), 13-17 September 2026, Montréal, Canada, www.13icg-montreal.org

☙ ❧

Eurock 2026
Risk Management in Rock Engineering - an ISRM Regional Symposium
15-19 September 2026, Skopje, Republic North Macedonia

Contact Person Name
Prof. Milorad Jovanovski
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☙ ❧

Shaping the Future of Earthquake Engineering
https://ecee2026.eu

The RPTU University of Kaiserslautern-Landau, TU Berlin and German Association for Earthquake Engineering and Structural Dynamics (DGEB) is delighted to invite you to the 18th European Conference on Earthquake Engineering (ECEE-2026), taking place from **14 to 18 September 2026 in Berlin**.

The ECEE2026 aims to impart a profound understanding of current research findings, innovative technologies, and forward-thinking strategies in earthquake engineering sciences.

Featuring a comprehensive program that includes lectures by leading experts, interactive workshops, and engaging panel discussions, we guarantee that every participant will gain valuable insights and new perspectives.

We are committed to making your participation not only professionally enriching but also scientifically and personally rewarding.

Divisions

01 Seismic Hazard and Seismology
02 Geotechnical Earthquake Engineering, SSI and Site Response
03 Ground Motions and Seismic Input
04 Seismic Modelling and Design
05 Evolution of Earthquake Engineering and Seismic Codes
06 Concrete Structures
07 Masonry Structures
08 Steel and Timber Structures
09 Non-Structural Elements
10 Experimental Testing
11 Structural Health Monitoring
12 Assessment and Retrofitting
13 Bridges, Civil Infrastructure and Industrial/Critical Facilities
14 Cultural Heritage and Historical Structures
15 Seismic Isolation and Energy Dissipation/Response Control Devices
16 Seismic Risk Assessment and Multi-Hazard Risk (incl. Tsunami, NaTech)
17 Post-Event Reconnaissance and Field Observations
18 Resilience of Communities and Infrastructure, Seismic Risk Management and Social/Economic Aspects

Contact us

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Institute of Structural Analysis and Dynamics
67663 Kaiserslautern, Germany
For general info general@ecee2026.eu
For queries on submissions: submission@ecee2026.eu
For registration issues: registration@ecee2026.eu

☙ ❧

International Symposium Preservation of Monuments & Historic Sites, 16 – 18 September 2026, Athens, Greece https://tc301-athens.com

6th International Conference on Information Technology in Geo-Engineering JTC2 Conference, 13-16 October 2026, Graz, Austria, www.icitg2026.com

☙ ❧

Slope Stability 2026

Slope for Safety Performance
an ISRM Specialized Conference
26 – 29 October 2026, Lima, Peru

Organizer: Sociedad Peruana de Geoingeniera (SPEG)

Contact Person Name: Antonio Samaniego and Luis Claudio Tejada Alvarez

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☙ ❧

PBD-V Chile International Conference on Performance-Based Design in Earthquake Geotechnical Engineering, November 4th to 6th, 2026, Puerto Varas, Chile www.pbd-v-chile.com

ARMS 14 Fukyoka 2026 - 14th Asian Rock Mechanics Symposium Rock Mechanics for the Next Generation –Innovations, Sustainability, and Resilience– an ISRM Regional Symposium, 22-26 November 2026, Fukuoka, Japan, www.ec-convention.com/ARMS14/

☙ ❧

16th International Congress on Rock Mechanics Rock Mechanics and Rock Engineering Across the Borders
17-23 October 2027, Seoul, Korea

Scope

The scope of the Congress will cover both conventional and emerging topics in broadly-defined rock mechanics and rock engineering. The themes of the Congress include but not be limited to the following areas:

- Fundamental rock mechanics
- Laboratory and field testing and physical modeling of rock mass
- Analytical and numerical methods in rock mechanics and rock engineering
- Underground excavations in civil and mining engineering
- Slope stability for rock engineering
- Rock mechanics for environmental impact
- Sustainable development for energy and mineral resources
- Petroleum geomechanics
- Rock dynamics
- Coupled processes in rock mass
- Underground storage for petroleum, gas, CO2 and radioactive waste
- Rock mechanics for renewable energy resources
- Geomechanics for sustainable development of energy and mineral resources
- New frontiers & innovations of rock mechanics
- Artificial Intelligence, IoT, Big data and Mobile (AICBM) applications in rock mechanics
- Smart Mining and Digital Oil field for rock mechanics
- Rock Engineering as an appropriate technology
- Geomechanics and Rock Engineering for Official Development Assistance (ODA) program
- Rock mechanics as an interdisciplinary science and engineering
- Future of rock mechanics and geomechanics

Our motto for the congress is "Rock Mechanics and Rock Engineering Across the Borders". This logo embodies the interdisciplinary nature of rock mechanics and challenges of ISRM across all countries and generations.

☙ ❧

XIXth European Conference on Soil Mechanics and Geotechnical Engineering "Connecting Continents Through Geotechnical Innovations"
04-08 September 2028, Istanbul, Turkey

Conference Topics

01 Modelling and Experimental Assessment of Geomaterials

02 Geohazards, Earthquakes and Risk Mitigation

03 Development of Resilient and Sustainable Geosystems

04 Geotechnical Construction and Soil Improvement

05 Geotechnical Engineering of Multiscale Observations, Sensors and Monitoring

06 Energy Geotechnologies

07 Technological Innovation

08 Geo Education, Standards And Codes

Contact

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ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Laser ultrasound tests space rock stiffness

Researchers at Nottingham University have employed a new technique that allows for the elasticity and stiffness of space rocks to be measured for the first time.

Gibeon meteorite, National Museum of Natural History, Washington DC - *Kinda Kinked - Flickr via CC*

Described in *Scripta Materialia*, the method was developed and patented in-house at Nottingham. It uses a laser ultrasound technique known as spatially resolved acoustic spectroscopy (SRAS++) to non-invasively test meteorites and other space objects. The technique was used to examine fragments of the Gibeon meteorite, composed of an iron-nickel alloy and significant amounts of cobalt and phosphorus, which was discovered in Namibia in the 19th century.

The relative scarcity and scientific value of these types of space materials means that alternative, destructive testing methods are not appropriate. Additionally, many meteorites are made of crystalline materials that are formed under extraterrestrial conditions not achievable on Earth, meaning samples for destructive testing cannot be replicated.

"These materials have evolved in unique conditions over millions of years to form these amazing structures and patterns," explained lead author Wenqi Li, from the University's Optics and Photonics research group.

"These conditions cannot be reproduced on Earth and meteorites have amazing large-scale microstructure and phase mixtures which gives mechanical and elastic properties that are quite different to the man-made iron-nickel alloys we can produce on Earth."

As well as information on the formation and evolution of planetary bodies, SRAS++ testing can provide insights into alloys for aerospace and industrial applications, and further our understanding of the potential for meteorites to act as a resource for extraterrestrial manufacturing.

"The SRAS++ machine uses lasers to make and detect acoustic waves that travel on the surface of the material, this means that we do not need to touch the sample and do not damage the sample in anyway," said Associate Professor Richard Smith. "This is really important for samples where there is limited supply.

"There are no published values to directly compare the results of this study, as non-destructive measurements of the single crystal elasticity on granular material has not previously been possible. So, we compared our results with theoretical values for man-made iron-nickel alloys. We also calculated the bulk properties from our single crystal elasticity measurements and compared them to published measurements on the Gibeon meteorite and they also agree well."

(THE ENGINEER, 20 May 2025, https://www.theengineer.co.uk/content/news/laser-ultrasound-tests-space-rock-stiffness)

Measuring the elastic properties of the Gibeon meteorite using laser ultrasound

Wenqi Li, Matt Clark, Richard J. Smith

Highlights

- Simultaneous non-destructive measurement of single crystal elasticity and crystallographic orientation of meteorite sample.
- Determined C_{ij} in close agreement with man-made iron-nickel alloy values.
- Calculated bulk properties in agreement with previous measurements in the literature.

Abstract

Meteorites provide access to information on the formation and evolution of planetary bodies which is otherwise difficult to study. The unique nature of these samples and their relative scarcity means that non-destructive analysis techniques are needed to study their properties.

This paper uses the laser ultrasound technique spatially resolved acoustic spectroscopy to non-destructively determine both the crystal orientation and the single crystal elastic constants (C_{ij}) of a sample of the Gibeon meteorite. There are no published values to directly compare the results of this study, as non-destructive measurements of the single crystal elasticity on granular material have not been possible. Therefore, comparisons with theoretical values for man-made iron-nickel alloys are given showing the C_{ij} values are in the expected range. There are studies providing bulk elastic properties of meteorites, and so calculated bulk properties derived from the single crystal elasticity measurements are compared and also agree well.

Scripta Materialia, Volume 262, 1 June 2025, 116666

https://www.sciencedirect.com/science/article/pii/S1359646225001290?via%3Dihub

Landslide destroys home in central Quebec, leaves massive scar in landscape

A major landslide struck Sainte-Monique in central Quebec, Canada, around 06:00 local time on May 21, 2025, sweeping away a house and cutting through a rural road. The event forced nearby residents to evacuate, but no injuries or missing persons were reported.

The slide left a large ground scar estimated at 760 m (2 493 feet) long and 150 m (492 feet) wide, cutting through a rural road. Public Safety officials confirmed no one was inside the house at the time of the collapse. The Red Cross is assisting evacuated residents, and a geologist has been brought in to investigate the cause of the landslide.

https://www.youtube.com/watch?v=th1elP5zgJc&t=94s

Sylvain Gallant, regional spokesperson for Quebec's Public Security Ministry, said it was too early to determine the exact cause of the landslide, but noted that the area had experienced significant rainfall in recent days.

Approximately 50 mm (1.97 inches) of rain fell in Trois-Rivières between Friday and Sunday, just 30 km (18.6 miles) from the affected area. Gallant said the landslide zone is likely to continue expanding due to the steep slope and the soil's high clay content. At its deepest point, the depression reaches around 24 m (78.7 feet).

Heavy rainfall earlier in the month also triggered a landslide along Route du Trou-de-la-Fée, collapsing part of the roadway and severing access between Desbiens and Saint-André-du-Lac-Saint-Jean. The road remains closed due to ongoing safety concerns.

Gallant advised that if homeowners notice anything unusual, such as cracks in the ground or trees starting to fall, they should report it to the city immediately so experts can be sent to assess the situation. However, in this case, he noted that there were no clear warning signs before the landslide occurred.

Featured image: Landslide in central Quebec, Canada on May 21, 2025. Credit: CBC (stillshot from video)

(Harsh Vardhan / THE WATCHERS, Thursday, May 22, 2025, https://watchers.news/2025/05/22/quebec-landslide-home-destroyed-scar)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ & ΑΝΤΙΣΕΙΣΜΙΚΗ ΜΗΧΑΝΙΚΗ

ASCE Library

Earthquake Collection

ASCE is reopening this earthquake collection in response to the recent 7.7-magnitude earthquake in Myanmar on March 28, 2025. This collection was first opened after the 7.8-magnitude earthquake that struck southeastern Turkey and northwestern Syria in February 2023, followed closely by the 7.4-magnitude earthquake off the coast of Taiwan on April 3, 2024. These ASCE Library papers have been opened to help structural engineers understand the vulnerabilities of buildings and better mitigate damage.

These papers are open to registered ASCE Library users through May 31, 2025. Register for Free

Papers in the Collection

Damage Observation of Reinforced Concrete Buildings after 2020 Sivrice (Elazığ) Earthquake, Turkey *Journal of Performance of Constructed Facilities*

Assessment of the Material Quality of Damaged Structures after Earthquake in Van, Turkey *Journal of Materials in Civil Engineering*

Effect of Displacement and Hysteretic Energy on Earthquake Damage in Reinforced Concrete Structures *Journal of Structural Engineering*

Model for Earthquake Damage Analysis in Lifeline Utility Systems with Consideration of Uncertainties *Journal of Infrastucture Systems*

Implementing a Practice-Focused Approach to Geotechnical Post-Earthquake Damage Assessment Geo-Extreme 2021

Cost of Environmental and Human Health Impacts of Repairing Earthquake Damage *Journal of Performance of Constructed Facilities*

Subsurface Explorations and Investigation of Foundation Performance for Distress Assessment of a Building *Journal of Performance of Constructed Facilities*

Parametric Study of Seismic Isolation Properties for Light-Frame Houses *Journal of Structural Engineering*

https://ascelibrary.org/earthquake-collection

Site-Specific Ground Motions for Seismic Design of Buildings and Other Structures https://ascelibrary.org/doi/book/10.1061/9780784415962

Dinosaur age tsunami revealed from tiny chunks of Japanese amber, study finds

Amber deposits in Japan show unique deformations that suggest trees were swept out to sea during a tsunami about 115 million years ago, giving paleontologists a new way to identify past tsunamis.

(Image credit: shannonstent via Getty Images)

Scientists have discovered evidence of an ancient tsunami in Japan — which is hidden in tree amber that dates to the age of the dinosaurs. The amber samples are deformed in a particular way that suggests trees and plant debris were rapidly swept out to the ocean and sank to the seafloor around 115 million years ago, the researchers said, which the team interpreted as evidence of one or more tsunamis. The scientists published their findings today (May 15) in the journal Scientific Reports.

Scientists typically estimate when tsunamis happened in the past using geological evidence such as giant fossilized boulders that were swept away and deposited onto coasts, or by looking at abrupt changes in sediment deposits near coastlines. However, it can be difficult to differentiate tsunami traces in the fossil record from severe storms, which leave similar deposits.

Amber, which is fossilized tree resin — a fluid produced by trees — can also be transported to the ocean when a tsunami sweeps trees and plant debris out to sea, leaving behind a record of the tsunami event.

In the new study, the researchers analyzed amber-rich silica deposits from the Shimonakagawa Quarry in northern Hokkaido, Japan, which were deposited sometime between 116 million and 114 million years ago, during the Early Cretaceous period (145 million to 100 million years ago), when this region was deep seafloor.

The team used fluorescence imaging — a technique that photographs the amber samples while shining ultraviolet light onto them — to observe the amber's structure.

The amber samples showed a pattern similar to what geologists call "flame structures," a deformation that happens when soft sediment is deposited somewhere and changes shape before fully hardening — resulting in upward-pointing, flame-shaped tongues between the sediment layers. Amber deposits more commonly form other shapes, as tree resin dries when exposed to air.

The research team interpreted the flame structures to mean the amber was suddenly swept out from the land to the ocean by one or more tsunamis, without being exposed to the air (which would have hardened it), then sank to the seafloor. The amber would have then been covered by a layer of silt and preserved for millions of years.

"Identifying tsunamis is generally challenging," and it was not immediately apparent that tsunamis were behind the unusual amber samples, study co-author Aya Kubota, a paleontologist at Chuo University in Tokyo, told Live Science in an email. "By combining detailed field observations with the internal structures of amber, we were able to conclude that the most plausible cause was tsunamis."

Other evidence from the area backed up this hypothesis, including signs of a nearby landslide around the same time that may have been caused by an earthquake; large chunks of mud seemingly ripped up by the destruction of the seafloor; and large tree trunks on what was at the time the seafloor. Severe storm waves would not have affected the seafloor in this way, and if the tree trunks were stacked slowly over time they would have shown evidence of erosion, which these trunks did not — meaning all the evidence points to a huge amount of plant debris being transported quickly and suddenly to the seafloor.

The researchers suggested that looking at ocean floor geological and fossil evidence — that is, beyond just coastal evidence — paints a more complete picture of previous tsunamis, and that examining amber deposits can provide information that helps differentiate tsunamis in the prehistoric record from severe storms.

"Resin offers a rare, time-sensitive snapshot of depositional processes," Kubota said. Although the study of amber has typically focused on organisms like insects trapped inside samples, "the emerging concept of 'amber sedimentology' holds exciting potential to provide unique insights into sedimentological processes," Kubota added.

(Olivia Ferrari / LIVESCIENCE, 15 May 2025, https://www.livescience.com/planet-earth/rivers-oceans/dinosaur-age-tsunami-revealed-from-tiny-chunks-of-japanese-amber-study-finds)

Amber in the Cretaceous deep sea deposits reveals large-scale tsunamis

Aya Kubota, Yusuke Takeda, Keewook Yi, Shinichi Sano & Yasuhiro Iba

Abstract

Large-scale tsunamis destroy coastal areas and rapidly transport huge amounts of plants and other debris over long distances. However, due to their poor preservation potential and the lack of unequivocal identifying features, tsunami deposits are rarely recognized in the geological record except for geologically young Holocene coastal deposits. This study focuses on pelagic settings as potential archives of large-scale paleo-tsunami events. Here we describe extraordinarily rich amber concentrations in Early Cretaceous deep sea deposits (116–114 Ma). The amber is distinctively deformed in a manner comparable to typical soft-sediment deformation structures such as flame structures. As resin exposed to the air hardens quickly in weeks, the flame deformation of the resin suggests that it reached pelagic seafloors without significant subaerial exposure. This new observation of amber as a soft-sediment unveils the whole sedimentary process from erosion to burial, a view neglected by previous sedimentological studies that focused on clastic and carbonate sediments. The most plausible cause for the presence of this enigmatic amber in a deep-sea setting is large-scale tsunamis, which are supported by the mode of occurrence of amber, associated sedimentary structures, and a massive coinstantaneous landslide.

Scientific Reports **volume 15**, Article number: 14298 (2025)

(https://www.nature.com/articles/s41598-025-96498-2)

There's a humongous boulder on a cliff in Tonga. Now we know how it got there

A massive boulder named Maka Lahi was recently found about 650 feet from the edge of a cliff in Tonga, and researchers believe that it may have been deposited by a tsunami around 7,000 years ago.

The Maka Lahi boulder was found over 600 feet inland from the edge of the cliff, and was likely swept there by a giant wave 7,000 years ago, scientists say. (Image credit: Martin Köhler, UQ.)

A massive boulder perched hundreds of feet from the edge of a cliff in Tonga appears to have been transported by an ancient tsunami, making it one of the biggest rocks moved by a wave on Earth.

The boulder, which was discovered in 2024 on the southern coast of the Tongan island of Tongatapu, sits 656 feet (200 meters) inland from the cliff edge, at an elevation of 128 feet (39 m) above sea level. And it is enormous, measuring 45.9 x 39.3 x 22 feet (14 x 12 x 6.7 meters) and weighing over 1,300 tons (1,180 metric tons) .

It's the world's largest cliff-top boulder and was first identified by locals. "We had been surveying the southern side of the island of Tongatapu looking along the coastal cliffs at evidence of past tsunamis," lead author Martin Köhler, a researcher at the University of Queensland in Australia, said in a statement. "We were talking to some farmers when they directed us to this boulder."

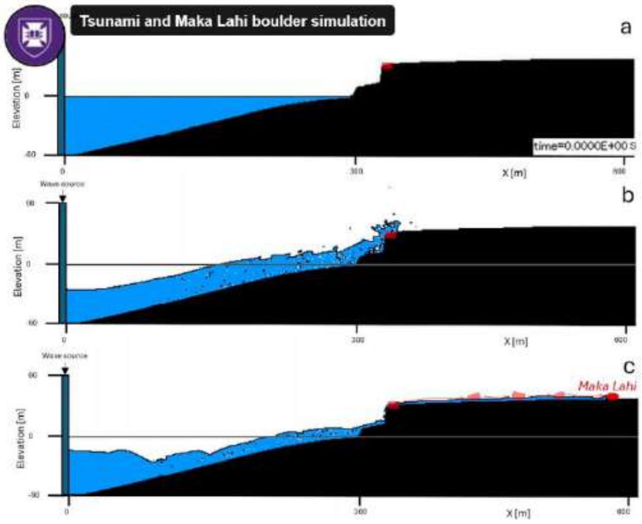
But exactly how the big rock ended-up on a cliff was unclear. "I was so surprised," Köhler said. "It is located far inland outside of our field work area and must have been carried by a very big tsunami. It was quite unbelievable to see this big piece of rock sitting there covered in and surrounded by vegetation."

According to a new study published online on 21 April in the journal Marine Geology, the boulder — named Maka Lahi, which is Tongan for "big rock" — may have been deposited in its unlikely home by a huge tsunami that struck the island around 7,000 years ago.

The researchers measured the boulder's properties then modeled how large a wave would have needed to be in order to deposit such a large rock so far inland. They suggested that the boulder originally sat at the cliff's edge, but was washed inland by a tsunami wave that lasted around 90 seconds and was up to 164 feet (50 m) tall – almost the height of Niagara Falls.

"We made a 3D model and then went back to the coast and found the spot the boulder could have come from, on a cliff over 30 metres above the sea level," Köhler said.

Based on dating methods involving isotopes present in the rock, Köhler and colleagues believe that the boulder was likely washed to its current location a minimum of 6,891 years ago, plus or minus 97 years. This date aligns with evidence of a huge tsunami that hit on New Zealand's North Island — around 1,300 miles (2,000 kilometers) south west of Tonga — between 7,240 and 6,940 years ago.



https://vimeo.com/1086637306

The Maka Lahi boulder may have moved because the wave's arrival coincided with an earthquake – a "coseismic" event. "It is possible that the earthquake not only generated a tsunami that inundated the North Island of New Zealand but also triggered a coseismic landslide, which in turn produced a separate tsunami that deposited Maka Lahi," the researchers wrote in the paper.

The islands of Tonga are located in the South Pacific Ocean, a region that is extremely prone to tsunamis due to being surrounded by tectonic plate boundaries known as the "Ring of Fire."

Subduction zones — where one plate is forced under another — or large underwater volcanic eruptions can generate powerful undersea earthquakes that can trigger tsunamis. The Tongan islands are located near the Tonga Trench, where the Pacific Plate is being subducted beneath the Indo-Australian Plate, making it especially vulnerable to tsunamis.

In 2022, Tongatapu was hit by a 62.3 feet (19 m) tsunami triggered by the eruption of the Hunga Tonga–Hunga volcano, with water reaching as far as 0.62 miles (1 km) inland.

"Tonga's most recent tsunami in 2022 killed 6 people and caused a lot of damage," Annie Lau, a coastal geomorphologist at the University of Queensland, said in the statement.

The researchers hope that this discovery of how far such a large boulder was moved by a wave may help Tonga and surrounding South Pacific nations prepare for large tsunamis.

"Understanding past extreme events is critical for hazard preparation and risk assessment now and in the future," Lau said. "The analysis strengthens our understanding of wave transportation of rocks to improve coastal-hazard assessments in tsunami-prone regions around the world."

(Jess Thomson / LIVESCIENCE, 28 May 2025, https://www.livescience.com/planet-earth/geology/theres-a-humongous-boulder-on-a-cliff-in-tonga-now-we-know-how-it-got-there)

Discovery of the world's largest cliff-top boulder: Initial insights and numerical simulation of its transport on a 30–40 m high cliff on Tongatapu (Tonga)

Martin Köhler, Annie Lau, Koki Nakata, Kazuhisa Goto, James Goff, Daniel Köhler, Mafoa Penisoni

Abstract

This study provides the first scientific investigation of the *Maka Lahi* boulder, a large limestone cliff-top boulder, measuring 14 × 12 × 6.7 m and weighing approximately 1180 t, located 200 m inland at 39 m elevation on the southern coast of Tongatapu, Tonga. The boulder is one of the largest known wave-transported boulders worldwide. Fieldwork conducted in 2024 revealed its presence, geo-morphic setting, and karstification features. Utilizing numer-ical modelling, we established that wave heights of approxi-mately 50 m and periods of 90 s were required to transport the boulder from its cliff-edge origin, suggesting that its em-placement likely resulted from a landslide-triggered tsunami event. U/Th dating of flowstone on the surface is indicative of a minimum age of 6891 cal yr BP and contributes critical evidence of a significant early Holocene tsunami event in Tonga. Notably, this represents the earliest known Holocene tsunami in the Pacific, offering new insights into the long-term history of extreme wave events in the region. This research strengthens the understanding of megaclast transport mechanisms and their implications for coastal hazard assessments in tsunami-prone regions.

Cite https://doi.org/10.1016/j.margeo.2025.107567Get rights and content

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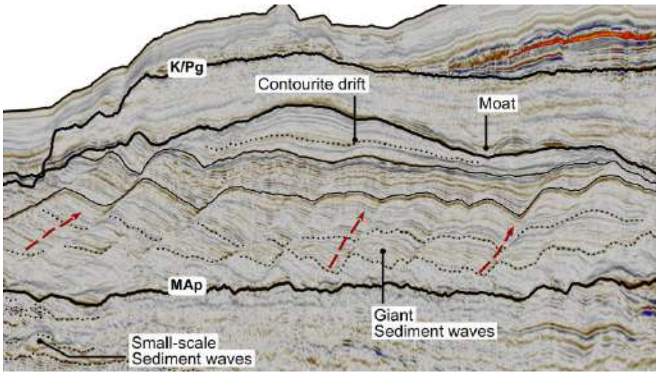
ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

Gigantic 'mud waves' buried deep beneath the ocean floor reveal dramatic formation of Atlantic when Africa and South America finally split

Enormous "mud waves" buried under the Atlantic seabed formed 117 million years ago as the Atlantic Ocean opened up.



The "mud waves" discovered off the coast of Africa, under the Atlantic Ocean, are hundreds of feet high and almost a mile long. (Image credit: courtesy of D Duarte et al/Heriot-Watt University)

The discovery of buried "mud waves" off the coast of western Africa reveals that the Atlantic Ocean was born at least 4 million years earlier than scientists previously thought.

These waves, each hundreds of feet high and over half a mile (1 kilometer) long, were caused by the mixing of extremely salty water from the southern hemisphere with less-salty water from the northern hemisphere as South America and Africa tore apart 117 million years ago, forming the Atlantic, according to new research published in the June issue of the journal Global and Planetary Change.

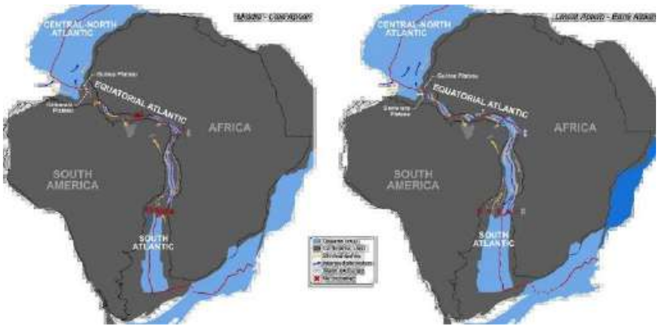
Previously, the Atlantic was thought to have finished opening between 113 million and perhaps 72 million years ago.

The giant waves were found in sediment cores drilled from 0.6 mile (1 km) below the seabed about 250 miles (400 km) west of Guinea-Bissau in 1975, as part of the Deep Sea Drilling Project. The ocean-drilling project confirmed that Earth's surface is broken into rafts of ever-moving tectonic plates.

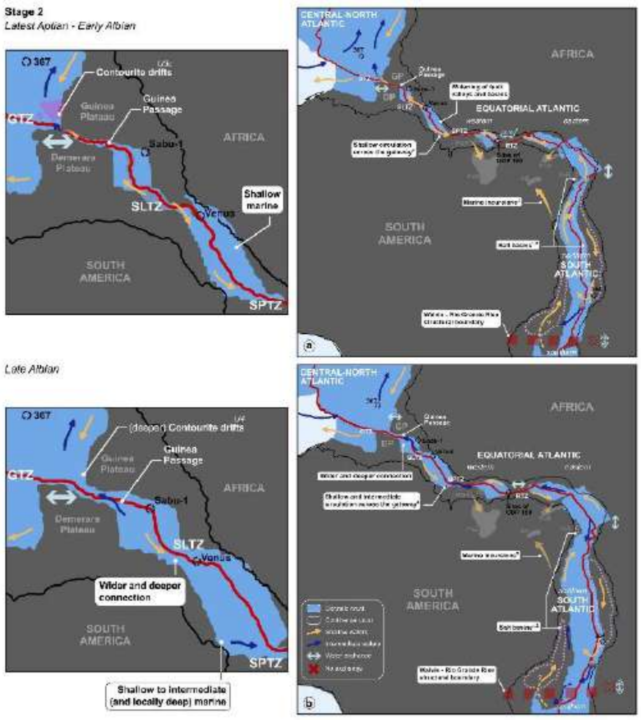
In further studying these cores, Heriot-Watt University geologists Débora Duarte and Uisdean Nicholson found evidence of huge mud waves in this region, which would have been the last spot to pull apart when Africa and South America split.

"Imagine one-kilometre-long waves, a few hundred metres high: a whole field formed in one particular location to the west of the Guinea Plateau, just at the final 'pinch-point' of the separating continents of South America and Africa," Nicholson said in a statement. "They formed because of dense, salty water cascading out of the newly formed gateway."

Before the Atlantic split South America and Africa for good, the final connection between the two continents would have been a series of deep basins, which were probably lakes, Duarte said in the statement.



The mud waves formed when water from the north and south, with very different salinities, were mixed together following the final split of South America and Africa. (Image credit: courtesy of D Duarte et al/Heriot-Watt University)



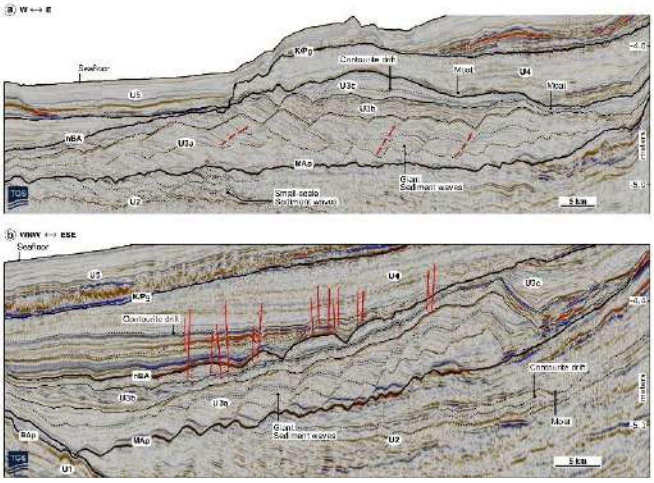
Reconstruction of the final stages of the separation of Africa and South America, with a series of basins between the North and South Atlantic. (Image credit: courtesy of D Duarte et al/Heriot-Watt University)

At that time, the South Atlantic was rich in salt deposits that made its water very saline, while the North Atlantic was less salty. This difference in salinity caused huge currents when the northern and southern Atlantic waters mixed. The currents, in turn, created the enormous mud waves along the seabed.

Over the eons, more sediment has buried the waves, locking them below the surface.

The existence of these waves 117 million years ago also suggests that the opening of the Atlantic caused Earth's climate to warm, Duarte said.

The basins that flooded in the final rifting of South America and Africa were rich in carbon, and the birth of the ocean would have made the sequestering of carbon less efficient. This reduced efficiency led to a period of warming between 117 million and 110 million years ago, the researchers said. After that, the ocean currents that circulate throughout the Atlantic stabilized, leading to a period of cooling.



The mud waves were buried beneath sediment over 117 million years, the researchers found. (Image credit: courtesy of D Duarte et al/Heriot-Watt University)

"This shows that the gateway played a really important role in global climate change," Duarte said in the statement.

(Stephanie Pappas / LIVESCIENCE, 14 May 2025, https://www.livescience.com/planet-earth/geology/gigantic-mud-waves-buried-deep-beneath-the-ocean-floor-reveal-dramatic-formation-of-atlantic-when-africa-and-south-america-finally-split)

Early Cretaceous deep-water bedforms west of the Guinea Plateau revise the opening history of the Equatorial Atlantic Gateway

Debora Duarte, Elisabetta Erba, Cinzia Bottini, Thomas Wagner, Benedict Aduomahor, Tom Dunkley Jones, Uisdean Nicholson

Highlights

- New seismic data reveal early opening of the Equatorial Atlantic Gateway (EAG).
- A two-stage model shows EAG started opening from ~117 Ma, earlier than thought.
- Sediment waves and contourites indicate dynamic overflow during EAG opening.
- Early EAG opening linked to significant changes in Cretaceous climate.

Abstract

The Equatorial Atlantic Gateway (EAG) was critical to Earth's climatic and oceanographic evolution during the Mesozoic, yet its early opening history remains enigmatic. Here, we present new 2D seismic reflection data and biostratigraphic ages from DSDP Site 367, integrated with tectonic reconstruction models, to constrain the sedimentary response to the evolution of the gateway. Seismic analysis reveals five stratigraphic units (*U1* to *U5*) documenting tectonic and oceanographic changes in the Guinea Plateau margin. Morphosedimentary features identified in units *U2* to *U4*, including sediment waves and contourite drifts, document changing current dynamics during EAG opening. We propose a two-stage model for the initial gateway opening: *i)* middle-late Aptian (~117 to ~113 Ma) formation of a marginal sea in the western EAG and overflow of Equatorial waters into the Central Atlantic, producing large sediment waves northwest of the gateway, and *ii)* latest Aptian-late Albian (from ~113 Ma onwards) widening and deepening of the gateway, establishing more continuous water exchange and leading to the transition into contourite deposition. This direct sedimentary evidence shows the establishment of a marine connection started at around 117 Ma, significantly earlier than previous estimates, and coinciding with the onset of global climate cooling. These findings show the dynamic interplay between gateway opening, ocean circulation, and climate change during the middle Cretaceous, highlighting the pivotal role of ocean gateways in Earth's climate system.

Cite https://doi.org/10.1016/j.gloplacha.2025.104777

https://www.sciencedirect.com/science/article/abs/pii/S0921818125000864

Africa is being torn apart by a 'superplume' of hot rock from deep within Earth, study suggests

Researchers have found fresh evidence that Africa is breaking apart because of a deep mantle superplume of hot rock beneath the East African Rift System.

The East African Rift System drives volcanic activity in places like the Erta Ale volcano in Ethiopia (pictured here). (Image credit: Mike Korostelev via Getty Images)

Researchers have found new evidence that a gigantic superplume of hot rock is rising beneath Africa, causing intense volcanic activity and splitting the continent in two.

Geologists have long known that Africa is slowly breaking apart in a region called the East African Rift System (EARS), but the driving force behind this massive geological process was up for debate. Now, a new study has presented geochemical evidence that a previously theorized superplume is pressing up against — and fracturing — the African crust.

Scientists found that gases at the Meengai geothermal field in central Kenya have a chemical signature that comes from deep inside Earth's mantle, likely from between the bottom of the mantle and the core. The signature matches those of gases found in volcanic rocks to the north, in the Red Sea, and to the south, in Malawi, indicating all of these places are sitting on the same deep mantle rock, according to a statement from the University of Glasgow in Scotland.

"The deep mantle signatures observed in different segments of EARS are remarkably similar, suggesting that they all originate from a common deep source," study first-author Biying Chen, a postdoctoral research associate in the School of Geosciences at the University of Edinburgh in Scotland, told Live Science in an email.

The researchers published their findings May 12 in the journal Geophysical Research Letters.

EARS is the largest active continental rift system on Earth, ripping through around 2,175 miles (3,500 kilometers) of Africa. The lithosphere, Earth's rocky outer shell of crust and upper mantle, has been gradually breaking apart across the rift for around 35 million years. This has left a network of valleys that carve through the top of the continent from the Red Sea off northeastern Africa to Mozambique in southern Africa.

Previous studies identified signs of a deep mantle plume beneath EARS in noble gas signatures. Noble gases, such as helium and neon, are rare and inert, which means they usually don't chemically react with other substances. As a result, they stick around for a long time, so researchers can use them to trace long-term geological processes. However, Chen noted that these geochemical tracers have been sparse and often controversial beneath EARS.

To help clarify what's going on beneath EARS, the team used high-precision instruments to look for neon (Ne) isotopes in Kenyan gases — and they detected a deep mantle signature. The signature in the gases is very similar to those of the most primordial (ancient) surface signatures in Hawaii, which is also thought to be sitting on a deep mantle plume.

"We were very excited to see the preliminary Ne isotope data showing the primordial deep mantle signature," Chen said. "But the deep mantle signature is small and we had to work hard to disentangle it — truthfully there was no Eureka moment, we frequently questioned the result and spent many hours checking and re-checking the data."

Once the team had rigorously assessed the data, they became confident that the signature was genuine and matched signatures found in other parts of the rift. Chen noted that the EARS plume likely originates from the core-mantle boundary, about 1,800 miles (2,900 km) deep inside the Earth.

While the EARS signatures are similar to those found in volcanic rocks on Hawaii, Chen noted that the Hawaii plume is proposed to be a discrete rising stream of hot mantle, a bit like a lava lamp, while the EARS plume is probably a different shape.

"More likely a large mass of upwelling of hot buoyant material from deep within the Earth has replaced the mantle that was originally beneath the EARS," Chen said. "As it has risen and meets the solid colder lithosphere it spreads out generating enough force to fracture the thin lithosphere, leading to intense volcanic activity in the region."

(Patrick Pester / LIVESCIENCE, May 27, 2025, https://www.livescience.com/planet-earth/geology/africa-is-being-torn-apart-by-a-superplume-of-hot-rock-from-deep-within-earth-study-suggests)

Neon Isotopes in Geothermal Gases From the Kenya Rift Reveal a Common Deep Mantle Source Beneath East Africa

Biying Chen, Domokos Györe, Thecla Mutia, Finlay M. Stuart

Abstract

The seismic velocity structure beneath East Africa suggests interconnected corridors of hot mantle are upwelling beneath the continent. However, the geochemical evidence for deep mantle in Ethiopia-Kenya-Tanzania volcanism is sparse questioning the existence of superplume. The development of new geothermal fields in the region offers the opportunity to access high temperature magmatic-hydrothermal fluids. Well gases from the geothermal field in the Menengai caldera in the central Kenya Rift have C-He isotope systematics that are dominated by magmatic volatiles. High precision Ne isotope data confirm a primordial deep mantle that has experienced long-term convective isolation like that beneath Hawaii is present beneath the Kenyan rift. The Ne isotope composition of the gases is indistinguishable from volatiles in basalts from the Afar plume and Western Rift (and significantly more precise) providing the first geochemical evidence for a common deep mantle beneath the entirety of the East African Rift System.

Key Points

- Geothermal gases from the Kenya Rift are primarily magmatic in origin
- High-precision Ne isotope measurement reveals a Hawaiian mantle plume-like signature
- This study provides the first robust geochemical evidence for a common deep mantle source beneath East Africa

Plain Language Summary

The East African Rift System (EARS) is the largest continental rift system on Earth, where the lithosphere is thinning and breaking apart. The driving force has been widely studied, with the most accepted explanation being a hot buoyant mantle upwelling rising from the core-mantle boundary beneath the South Atlantic Ocean. While geophysical studies strongly support this model, some alternative explanations have been proposed due to the limitations of analytical techniques. Geochemical studies on volcanic rocks and fluids provide critical evidence of mantle dynamics. Noble gas isotopes are key indicators of volatile origins, but their trace amounts are often affected by air contamination or noble gases generated in situ within the lithosphere. Previous noble gas studies in the EARS confirmed a deep mantle plume in some areas but lacked region-wide coverage. By analyzing noble gases from a new geothermal field in the Kenya Rift, where contamination is minimal, we identified volatiles sourced from the deep mantle. Their Ne isotopic features match those observed in other parts of the EARS, providing the first solid evidence for the sub-EARS mantle is fed by a common deep plume.

First published: 12 May 2025

https://doi.org/10.1029/2025GL115169

https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2025GL115169?af=R

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΠΕΡΙΒΑΛΛΟΝ

Scientists think a hidden source of clean energy could power Earth for 170,000 years — and they've figured out the 'recipe' to find it

Researchers have compiled a list of "ingredients" that could help resource exploration companies locate huge reservoirs of clean hydrogen, a critical element in the transition away from fossil fuels.

Finding reservoirs of hydrogen in Earth's crust could help accelerate the energy transition away from fossil fuels. (Image credit: Simon Dux via Alamy)

Recent breakthroughs suggest that hydrogen reservoirs are buried in countless regions of the world, including at least 30 U.S. states.

Finding such reservoirs could help accelerate a global energy transition, but until now, geologists only had a piecemeal understanding of how large hydrogen accumulations form — and where to find them.

"The game of the moment is to find where it has been released, accumulated and preserved," Chris Ballentine, a professor and chair of geochemistry at the University of Oxford and lead author of a new review article on hydrogen production in Earth's crust, told Live Science in an email.

Ballentine's new paper starts to answer those questions. According to the authors, Earth's crust has produced enough hydrogen over the past 1 billion years to meet our current energy needs for 170,000 years. What's still unclear is how much of that hydrogen could be accessed and profitably extracted.

In the new review, published Tuesday (May 13) in the journal Nature Reviews Earth and Environment, the researchers draw up an "ingredient" list of geological conditions that stimulate the creation and build-up of natural hydrogen gas belowground, which should make it easier to hunt for reservoirs.

"The specific conditions for hydrogen gas accumulation and production are what a number of exploration companies (e.g. Koloma, funded by a consortium led by Bill Gates Breakthrough Energy fund, Hy-Terra funded by Fortescue, and Snowfox, funded by BP [British Petroleum] and RioTinto) are looking at carefully and this will vary for different geological environments," Ballentine said.

Natural hydrogen reservoirs require three key elements to form: a source of hydrogen, reservoir rocks and natural seals that trap the gas underground. There are a dozen natural processes that can create hydrogen, the simplest being a chemical reaction that splits water into hydrogen and oxygen — and any type of rock that hosts at least one of these processes is a potential hydrogen source, Ballentine said.

"One place that is attracting a lot of interest is in Kansas where a feature called the mid continental rift, formed about 1 billion years ago, created a huge accumulation of rocks (mainly basalts) that can react with water to form hydrogen," he said. "The search is on here for geological structures that may have trapped and accumulated the hydrogen generated."

Based on knowledge of how other gases are released from rocks underground, the review's authors suggest that tectonic stress and high heat flow may release hydrogen deep inside Earth's crust. "This helps to bring the hydrogen to the near surface where it might accumulate and form a commercial resource," Ballentine said.

Within the crust, a wide range of common geological contexts could prove promising for exploration companies, the review found, ranging from ophiolite complexes to large igneous provinces and Archaean greenstone belts.

An ophiolitic landscape in Italy's Sondrio province. The rocks are rich in iron, which gives them a reddish-brown color. (Image credit: Michele D'Amico supersky77/Getty Images)

Ophiolites are chunks of Earth's crust and upper mantle that once sat beneath the ocean, but were later thrust onto land. In 2024, researchers discovered a massive hydrogen reservoir within an ophiolite complex in Albania. Igneous rocks are those solidified from magma or lava, and Archaean greenstone belts are up to 4 billion-year-old formations that are characterized by green minerals, such as chlorite and actinolite.

The conditions discussed in the review are the "first principles" for hydrogen exploration, study co-author Jon Gluyas, a professor of geoenergy, carbon capture and storage at Durham University in the U.K., said in a statement. The research outlines the key ingredients that companies should consider when developing their exploration strategies, including processes through which hydrogen might migrate or be destroyed underground.

"We know for example that underground microbes readily feast on hydrogen," co-author Barbara Sherwood Lollar, a professor of Earth sciences at the University of Toronto, said in the statement. So environments where bacteria could come in contact with hydrogen-producing rocks may not be great places to look for reservoirs, Sherwood Lollar said.

Hydrogen is used to make key industrial chemicals such as methanol and ammonia, which is a component in most fertilizers. The gas could also aid the transition away from fossil fuels, as hydrogen can power both cars and power plants.

But hydrogen today is produced from hydrocarbons, meaning manufacture of the gas comes with huge carbon emissions. "Clean" hydrogen from underground reservoirs has a much smaller carbon footprint, because it occurs naturally.

Earth's crust produces "plenty of hydrogen," Ballentine said, and it is now a question of following the ingredient list to find it.

(Sascha Pare / LIVESCIENCE, 14 May 2025, https://www.livescience.com/planet-earth/geology/scientists-think-a-hidden-source-of-clean-energy-could-power-earth-for-170-000-years-and-theyve-figured-out-the-recipe-to-find-it)

Natural hydrogen resource accumulation in the continental crust

Chris J. Ballentine, Rūta Karolytė, Anran Cheng, Barbara Sherwood Lollar, Jon G. Gluyas & Michael C. Daly

Abstract

Naturally occurring hydrogen accumulations could be an important source of clean hydrogen for hard-to-abate industry use and energy, but societally important reserves have yet to be proven. In this Review, we explore the conditions that enable the development of natural hydrogen resources in the geological subsurface, by examining the processes of hydrogen generation, migration, accumulation and preservation. Natural hydrogen is generated within the continental crust by two key mechanisms, water–rock reactions where Fe^{2+}, dominantly in ultramafic rocks, is oxidized to Fe^{3+}, and by radiolysis of water via radioactive elements U, Th and K found in upper-crustal rocks. These two generation reactions operate on very different timescales, ranging from thousands to millions of years for water–rock reactions in highly fractured rocks, to tens to hundreds of millions of years for water-limited water–rock and radiolysis reactions. Different globally widespread terrane types have the potential for hydrogen accumulations: continental margin ophiolite complexes, alkaline granite terranes, large igneous provinces, and Archaean greenstone belts and tonalite–trondhjemite–granodiorite granitic batholiths. Exploitation of natural hydrogen would have a low-carbon footprint, but continental systems do not provide a regenerating system on decadal to centennial timescales, and should not be considered a renewable resource. Calculating hydrogen generation by water–rock reactions is subject to more uncertainty than radiolysis reactions, but improving these estimates should be a priority for future research.

Key points

- Over the past billion years, the Archaean crust alone has generated volumes of hydrogen energy equivalent to ca 170,000 years of present-day societal oil use. However, it is not known how much of this hydrogen has been preserved in societally relevant accumulations.
- Natural hydrogen accumulation requires a source rock, water within the source rock, transport and a trap to retain the hydrogen. The generation and preservation of a gas phase is essential for economic recovery.
- Gas accumulations of high-purity (>90%) hydrogen are known to occur (such as the Bourakebougou reserve found in Mali), but hydrogen mixed with helium, nitrogen and other gases are predicted in many settings.
- Helium, readily detected in near-surface fluids, provides a critical analogue to hydrogen, and can illustrate regional controls on deep gas release, transport and gas-phase formation.
- A basic understanding of the geological controls of hydrogen generation by radiolytic and water–rock reaction pathways exists and enables exploration to find the most prospective regions.
- The mantle is not a source of hydrogen gas found in the crust or near surface, as mantle-derived hydrogen is most stable as water at pressures and temperatures shallower than ca. 90 km depth.

Nature Reviews Earth & Environment **volume 6**, pages 342–356 (2025)Cite this article

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ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ

Vertical Wick Drains

AUSTROADS TECHNICAL SPECIFICATION ATS 2260

Edition:1.1 May 2025

Austroads Technical Specification ATS 2260 sets out the requirements for the supply and installation of vertical Wick Drains.

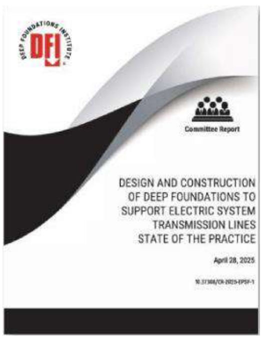
A wick drain is a prefabricated synthetic geocomposite drain which, when installed vertically in soft compressible soil strata, acts as a drainage medium with the ability to:

1. permit porewater in the soil to seep into the drain; and
2. transmit collected porewater along the length of the drain.

PDF (free) Download

This technical specification can also be downloaded as a Word document.

https://austroads.gov.au/__data/assets/pdf_file/0028/738334/ATS-2260-25_Vertical_Wick_Drains.pdf



Design and Construction of Deep Foundations to Support Electric System Transmission Lines State of the Practice

Unlike the commercial building and transportation sectors, the electric transmission industry does not have a unified code that explicitly covers design and construction of the various foundation types currently utilized to support electrical structures; there is no overarching professional group that leads this effort. Existing guide documents developed by various utility and non-utility organizations describe general design methodology for foundation types used in the electric power industry, but their application, relevance and approach vary significantly from utility to utility. For this reason, DFI established the Electric Power Systems Foundations Working Group in 2013 and upgraded the Group to Committee status in 2018 after significant growth in membership and activity.

This document summarizes the state of practice for the design and construction of electric system transmission lines for the purpose of aiding with future development of guidelines for the industry. This document is founded around recent industry state of the practice surveys performed by the Electric Power Research Institute (EPRI) (DiGioia 2010) and by this committee (Kandaris and Davidow 2015). Discussions provided are extended narratives of the various design and construction topics from the surveys and are based on the engineering judgment and knowledge of the committee members, along with many industry professionals who drafted sections and provided input via review to the document.

Keywords: foundations, transmission line, structure, electric, design

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Publication Date: 04/28/2025

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ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

International Journal of Geoengineering Case Histories
www.geocasehistoriesjournal.org/pub

28 May 2025

We are pleased to announce the release of Issue #1 of Volume #8 of the International Journal of Geoengineering Case Histories, an official Journal of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

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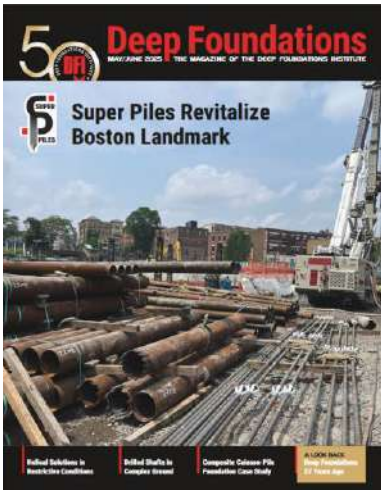

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