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Abstract of PhD Theses

Abstract 1:

Title of Thesis:	Characterization of Inherent Strength Anisotropy and Cracking Behavior of 3D-Printed Rock-Like Gypsum Specimens
Name of PhD Candidate:	Yulong Shao
Supervisor:	Jae-Joon Song
Year:	2024
University/Institute:	Seoul National University, Seoul, South Korea

Abstract

Rock mechanics focuses on the study of the mechanical properties, deformation behavior, and fracture mechanisms of rocks. However, accurately simulating the mechanical behavior of natural rocks in laboratory experiments has remained a challenge due to the complexity and significant anisotropy of rocks. 3D printing (3DP) technology, with its high precision and customizability, has garnered attention in rock mechanics. Nevertheless, most studies treat 3D-printed specimens as isotropic, neglecting the anisotropy introduced by the printing process. Additionally, current research tends to focus on macro-scale failure phenomena, with insufficient quantitative analysis of microstructures and crack propagation mechanisms, limiting a comprehensive understanding of their crack behavior. In addition, the commonly used printing materials for fabricating rock analogs, such as gypsum and sand, are currently only capable of substituting low-strength sedimentary rocks (e.g., sandstone). This limitation restricts their broader application in rock mechanics. To advance the widespread use of 3DP technology in rock mechanics, addressing issues related to anisotropy and lower strength, while deepening the study of micro-scale cracking mechanisms, is essential.

Firstly, to comprehensively investigate the factors influencing the anisotropy of 3D-printed gypsum specimens and the underlying formation mechanisms, a series of macro-scale mechanical tests, compositional analyses, and microstructural tests on specimens printed on different planes were conducted. The results indicate that two key factors contribute to the anisotropy in 3D-printed gypsum specimens: the bedding planes and the movement direction of the printer head. This anisotropy is primarily caused by weakly bonded layers and variations in the path and amount of binder applied during the movement of the printer head. By comparing the mechanical properties and failure modes of 3D-printed gypsum specimens with those of bedded rocks, it was found that 3D-printed gypsum specimens can, to some extent, mimic the behavior of low-strength bedded rocks. Based on this, subsequently, 3D-printed bedded rocks containing a single flaw were prepared. Through compression tests on 3D-printed bedded rocks with different bedding and flaw angles, the coupled effects of bedding planes and flaws on the mechanical properties of bedded rocks were explored. By analyzing real-time full-field displacement and strain data on the specimen surface, the results revealed that the bedding planes play a dominant role in the mechanical properties and crack behavior of pre-flawed bedded rocks.

Further, to investigate the mechanical anisotropy and micro-scale damage evolution, in-situ compression tests with a Micro-CT scanner were conducted on 3D-printed gypsum specimens with different bedding orientations. A novel void ratio variable, derived from 2D CT images using the mean and variance of CT intensity, was incorporated into a constitutive model. Crack evolution and morphology were analyzed through 3D models reconstructed from CT images. The results show that 3D-printed gypsum specimens exhibit mechanical anisotropy similar to natural sedimentary rocks, caused by bedding planes and pillar-like structures formed by needle-like gypsum crystals. The proposed constitutive model successfully captured the stress-strain behavior observed in the experiments, offering insights into failure mechanisms and microstructural evolution. In addition, to study the influence of initial flaws on micro-crack behavior and damage evolution during loading, in-situ uniaxial compression tests were performed on 3D-printed gypsum specimens with a pre-existing flaw. The 3D crack morphology, reconstructed from 2D CT images, showed tensile cracks forming near the flaw, followed by shear or mixed-mode cracks at flaw tips. A negative correlation was found between crack initiation angles and flaw angles: more cracks formed at flaw angles between 0° and 45°, while fewer and slower-growing cracks were observed between 45° and 90°. The micro-crack behavior and failure modes were similar to those in pre-flawed natural rocks, demonstrating the potential of 3DP technology in rock mechanics.

Finally, to significantly enhance the mechanical strength of 3D-printed gypsum specimens, the effects of post-processing methods, dipped infiltration treatment and vacuum infiltration treatment on the physical and mechanical properties of 3D-printed gypsum specimens were compared. Additionally, the impact of commonly used infiltrants, including water, saltwater, ColorBond, and StrengthMax, on the physical and mechanical characteristics of these specimens were evaluated. The results showed that the strength of non-treated specimens and specimens treated with water and saltwater was much lower than that of those treated with ColorBond and StrengthMax. In water-treated and saltwater-treated specimens, water or saltwater treatment can alter particle characteristics, but weak adhesive bonding and numerous pores result in low mechanical strength. Specimens treated with Colorbond or StrengthMax exhibit improved strength due to effective gap filling and cohesive structure formation, with StrengthMax-treated samples showing higher strength despite having more pores than Colorbond-treated ones. Moreover, the physical and mechanical properties of these treated samples matched a wider range of natural rock types compared to the untreated specimens.

In summary, this research achieved significant advancements in understanding and optimizing the mechanical behavior of 3D-printed gypsum specimens, successfully addressing challenges related to anisotropy, low strength, and micro-cracking mechanisms. These findings establish a solid foundation for the broader application of 3DP technology in experimental rock mechanics, providing a viable method for simulating the mechanical behavior of natural rocks in a controlled environment.

Abstract 2:

Title of Thesis:	Lithological Control on the Estimation of Geo-mechanical Properties of Lower Gondwana Coal Measures Rocks of India
Name of PhD Candidate:	Tabish Rehman
Supervisor(s):	Prof. Kripamoy Sarkar, IIT (ISM) Dhanbad, India
Year of Award:	2023
University/Institute:	Indian Institute of Technology (Indian School of Mines [IIT (ISM)], Dhanbad, India

Abstract

The physico-mechanical and elastic properties of rocks are critical for understanding rock behavior in ground engineering applications across industries like geotechnical, mining, civil, and petroleum. Direct measurement methods for parameters such as uniaxial compressive strength (UCS), Brazilian tensile strength (BTS), and static elastic properties (e.g., Young's modulus, shear modulus, bulk modulus, and Poisson's ratio) are challenging, time-intensive, and destructive. As alternatives, indirect methods like P-wave velocity (V_P), density (ρ), point load strength index (PLSI), shore hardness, and Schmidt hammer rebound number (R_N) are widely used due to their simplicity, cost-effectiveness, and precision. Researchers have developed regression equations for UCS estimation, but these often lack lithological specificity or high-range applicability.

This study focuses on coal measure rocks (sandstone and shale) from the Lower Gondwana basin (Damodar and Mahanadi River valley systems) associated with the Raniganj, Jharia, and Talchir coalfields. These rocks, encountered in open-cast and underground coal mines, necessitate accurate geomechanical characterization for safe and efficient mine design. UCS, BTS, ρ, and dynamic elastic properties (e.g., dynamic Young's modulus, shear modulus, bulk modulus, and Poisson's ratio) were correlated with V_P, yielding regression models that indicate a direct relationship between V_P and most properties except dynamic Poisson's ratio. Strength properties under saturated conditions were also analyzed, and regression models were proposed for UCS estimation from dry condition parameters.

The study validates proposed models using data from over 37 previous studies encompassing various rock types, such as sandstone, carbonate, shale, volcanite, and others. Principal component analysis (PCA) demonstrated lithological control on correlations, while artificial neural networks (ANNs) further enhanced predictive accuracy. Comparative analysis of ANN and regression models highlighted the superior performance of ANN-based predictions. Statistical tools, including mean absolute percentage error (MAPE), root mean square error (RMSE), and correlation coefficient (R), confirmed the robustness of these models. The findings underscore the importance of lithology-specific regression equations and ANN models for accurately predicting geomechanical properties, aiding engineers in ground engineering applications.

Abstract 3:

Title of Thesis:	Mining front stability assessment using diametrical core deformation analysis and numerical modelling
Name of PhD Candidate:	Yizhuo Li
Supervisor:	Hani S. Mitri
Year of Award:	2024
University/Institute:	McGill University, Canada

Abstract

Regularly estimating mining-induced stress is crucial due to variations in stress depending on many factors like depth, proximity to geological structures, and the history, geometry, and orientation of excavations with respect to principal in-situ stresses. As the mining operation progresses, stress near drifts, ramps, and sill drives changes dynamically, affecting stability and potentially causing rock failure. Mature in-situ stress measurement techniques are costly, time-intensive, and infrequent. This highlights the need for a practical, rapid, and cost-effective stress estimation method.

This study focuses on the development of a near-field stress estimation technique using the rock cores. Specifically, the local stress field is predicted through the diametrical core deformation. The thesis begins with a review of existing underground stress measurement methods, identifying limitations and positioning the proposed method as superior. A laboratory test system was developed to measure core diameters continuously in 360 degrees for common core sizes. Case studies in two mines reveal the feasibility of a designed measuring system and the application of diametrical core deformation analysis in hard rock mines. A new analytical model based on core deformation analysis was created to determine planar major and minor principal stresses near mining fronts. The model was verified through laboratory experiments, showing strong agreement between estimated and applied stresses. The technique, called the Diametrical Core Deformation Technique (DCDT), was applied in two underground gold mines. The near field stresses are estimated and serve for the validation of DCDT through previous field measurements and numerical modelling. DCDT proved effective for near-field stress estimation and mining front stability assessment, offering a practical tool for improving safety and operational efficiency in hard rock mining.

Abstract 4:

Title of Thesis:	Explosive-free breakage of biaxially loaded rock using soundless chemical demolition agents
Name of PhD Candidate:	Tuo Chen
Supervisor:	Hani S. Mitri
Year of Award:	2023
University/Institute:	McGill University, Canada

Abstract

Drilling and blasting with explosives is a conventional method for rock breakage in mining and civil engineering. However, environmental concerns and the shift toward low-carbon, green mining have driven interest in alternative methods. One promising solution is the use of Soundless Chemical Demolition Agents (SCDA), which are cementitious powders primarily composed of calcium oxide (CaO). When mixed with water and poured into boreholes, SCDA expands as CaO hydrates into portlandite $Ca(OH)_2$, generating pressure that fractures the rock. This thesis is part of a multi-phase project aimed at developing SCDA for large-scale hard rock fragmentation in underground mines. It focuses on evaluating SCDA performance under biaxial confinement, a stress condition typical at mining fronts. The study begins with a comprehensive review of SCDA's composition, physical properties, fracturing behavior, modeling techniques, and field applications. Numerical simulations using PFC2D and FLAC3D were conducted on panels with various SCDA borehole patterns. Five models were analyzed, and optimal designs were selected for laboratory testing. The diamond-shaped pattern successfully fractured concrete and rock panels, demonstrating SCDA's potential in hard rock environments. A second series of experiments tested a V-shaped hole pattern with 45° inclined drill holes. FLAC3D simulations and lab tests confirmed this pattern's effectiveness, with granite panels collapsing in under 12 hours using fewer SCDA holes than the diamond pattern. This suggests the V-pattern is a more efficient design for SCDA application. Finally, a novel method was developed for loading SCDA into non-vertical holes using 3D-printed cartridges. This technique was successfully implemented in an underground mine, enabling SCDA use in orientations where gravity-based filling is not feasible. Overall, the research demonstrates SCDA's viability as an effective, environmentally friendly alternative to explosives for rock breakage in underground mining.

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News & Views

Mumbai-Pune Expressway: Asia's widest road tunnel opens on 1st May 2026 in Maharashtra, India

Asia's widest road tunnel, the Mumbai-Pune Expressway, opens to the public on Maharashtra Foundation Day, May 1. Maharashtra Chief Minister Devendra Fadnavis inaugurated it. It cuts travel time by 20-25 minutes and bypasses the steep, accident-prone Bhor ghat section that frustrated commuters for decades due to heavy traffic jams. This project, also named the Missing Link corridor, connects Khopoli (in Raigad) on the Mumbai side to Kusgaon near Lonavala in Pune district of western Indian state Maharashtra.

Developed by the Maharashtra State Road Development Corporation (MSRDC), the project includes two tunnels, two viaducts and a cable-stayed bridge over Tiger Valley. At 23.75 m wide and eight lanes across, the Missing Link's 8.9 km tunnel is eyeing a Guinness World Record as the world's widest road tunnel, a statement that India can build what few countries dare to attempt. With eight lanes, emergency shoulders, full access control, and tunnels built to handle high-speed traffic, the Missing Link is not a road-widening project dressed up as something bigger. It is a fundamentally different kind of highway infrastructure for India. 170 feet below the Lonavala Lake bed, construction crews worked in near-impossible conditions to ensure the tunnel above would not disturb the water table above it. The precision required was extraordinary even by global standards.

The Tiger Valley cable-stayed bridge soars 170 to 180 m above the valley floor, roughly the height of a 55-storey building, and was designed to withstand the ferocious wind loads the Sahyadris throw at the Western Ghats every monsoon season.

At 13.3 km, the Missing Link corridor replaces one of India's most dreaded road stretches, not with a wider version of the same ghat nightmare, but with tunnels, viaducts and bridges that cut through the mountain rather than crawl over it. The Tiger Valley Bridge, spanning 640 to 650 m, ranks among Asia's tallest road bridges. Wind-load testing for its design was conducted at specialized facilities abroad, a rare step for an Indian highway project that signals just how seriously engineers took the Sahyadri weather.

Source: News18, 01.05.2026 & The Hindu, 02.05.2026

Rishikesh to Karnprayag rail line in Indian Himalayan state Uttarakhand is over 72% complete

Work on the 126 km Rishikesh-Karnprayag rail line has reached 72.5% completion, with 95.3% of tunnelling finished, informed officials during a review meeting chaired by Chief Minister Pushkar Singh Dhami on Wednesday. A total of 28 tunnels is being constructed under this project, including 16 main tunnels and 12 escape tunnels.

Chief Minister of Uttarakhand Mr. P. S. Dhami directed officials to ensure that future rail projects in the state include escape tunnels alongside main tunnels to serve as parallel evacuation routes during emergencies. “An action plan should be prepared on how the escape tunnels built under the Rishikesh-Karnprayag project can be utilized in the future,” he said. He also asked officials to examine the feasibility of extending the line from Karnprayag to Bageshwar.

On the proposed Tanakpur-Bageshwar rail line, officials said Indian Railways has suggested three survey options, and plans are also being explored to connect Almora and Someshwar to the proposed corridor. The state would urge the Centre to declare it a national project to speed up its execution.

Source: Times of India, 12.02. 2026

Shyok tunnel will boost India's border defence

The 920 m cut-and-cover tunnel, built at an elevation of around 3600 m, circumvents a landslide-prone stretch of the Shyok riverbank that has historically disrupted logistics. Winter conditions in the sector routinely trigger road closures due to heavy snowfall, flooding, and high-velocity winds, affecting resupply and troop rotation to forward areas.

Authorities say the structure provides the first reliable, all-weather link on a route long constrained by geography and climate.

“The tunnel will significantly enhance security, mobility, and rapid deployment capabilities, especially during harsh winters,” the Defence Minister said at the inauguration, calling it an “engineering marvel”.

Engineers from the Border Roads Organization (BRO) said construction at that altitude posed complex challenges. Machinery performance drops sharply in low-oxygen conditions, labour productivity declines, and the annual working window in the region is among the shortest in the Himalayas. “Every metre of progress had to be fought for - against weather, altitude and time,” said a BRO official.

Daulat Beg Oldie, India’s northernmost military post, lies about 9 km from the LAC. The DS-DBO road runs parallel to the frontier and is viewed by India as a critical line for maintaining access to sensitive areas around Aksai Chin and the Chip Chap and Jiwan Nallah valleys.

Source: Excerpts, https://thehindubusinessline.com, 09.12.2025

Underground infrastructures: A planning blind spot!!

A sewage leak in Indore that contaminated a drinking water pipeline, killing at least ten people, is symptomatic of a profound governance vacuum beneath Indian cities. Above ground, elaborate regulations govern land use, building heights, setbacks, and environmental clearances. Below ground, no such regime appears to exist. The consequences are bound to be grave and recurring: drinking water turns toxic, sanitation workers perish from sewer gases in manholes, and basements become death traps during monsoons. Each incident is dismissed as local negligence while the systemic failure goes unaddressed.

“These incidents essentially reflect gaps in planning, governance, and design related to subsurface infrastructure.” - R. K. Goel, Former Chief Scientist, CSIR-CIMFR; Specialist in Underground Space Design and Tunnelling.

Architect Manit Rastogi, founding partner at Morphogenesis, agrees that basement drownings and tunnel flooding in Delhi, groundwater contamination in Indore, and other such incidents are not freak accidents but predictable outcomes of a failure to govern underground space. “Indian urban planning remains largely two-dimensional. We regulate the surface but treat the underground as an unregulated frontier,” he says.

Globally, the underground matters

Worldwide, many cities have recognized that underground space is finite – and must be planned as carefully as surface land. Countries such as Singapore, the Netherlands, and Finland have come up with elaborate master plans and 3D zoning frameworks to determine where different functions – like transportation tunnels, utilities, and storage, basements, or energy infrastructure – can be located and even how deep they can go. These plans take into account geology, groundwater conditions, flood risk, and future demand before space is allocated.

Helsinki’s Underground Master Plan, approved in 2010, has become a benchmark. It maps the entire municipal area in three dimensions, reserves underground corridors for future infrastructure, and treats the subsurface as an important urban asset. All public agencies and private developers are legally required to align projects with this framework.

Similarly, Singapore’s 2019 Underground Master Plan, prepared by the Urban Redevelopment Authority, zones underground depths for utilities, data centres and transport, freeing up surface land for housing and public spaces in the land-scarce city-state.

Although state town planning acts and municipal master plans mention underground infrastructure - often guided by the 2015 Urban and Regional Development Plans. Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines generally focus on surface land use and two-dimensional planning. They do not provide a dedicated framework for subsurface governance, such as 3D zoning, depth-based allocation, or underground master plans.

Experts say in many Indian cities, tunnels and basements are built below natural drainage paths or adjacent to already overloaded stormwater drains. During intense rainfall – now more frequent and erratic due to climate change – water follows the path of least resistance, into the underground.
“In fact, this is one of the most underestimated risks in Indian urbanism. Underground systems do not fail independently. They fail at points of interaction. When basements intersect drainage paths, when tunnels alter groundwater movement, or when utilities overlap without hierarchy, risk accumulates silently. These interactions are rarely mapped or analysed together,” says Dikshu Kukreja, an architect and managing principal, CP Kukreja Architects (CPKA). “As underground construction accelerates in dense urban cores, the probability of cascading failures increases, often surfacing during extreme weather events such as monsoons”.

A warning unheeded

Experts have long warned of the risks of neglecting underground planning.

A 2022 National Institute of Disaster Management (NIDM) report, *Underground Urbanism: Re-imagining the Role of Underground Spaces for India’s Urban Future,* echoed these concerns, calling for a more strategic and integrated use of subsurface space through policy, planning, and innovation.

"In spatial policies and other strategic plans, underground spaces are often overlooked due to a lack of awareness and understanding by policymakers, decision-makers and planners – on how these spaces can assist in achieving policy goals and contribute to achieving sustainable development goals (SDGs)," said the report.

In his 2012 book, *Underground Infrastructures: Planning, Design, and Construction,* which deals with the planning, design, construction, and maintenance of underground structures Dr. R.K. Goel, along with Professors Bhawani Singh and Jian Zhao, argues if planned and governed well, underground space can ease land scarcity in dense cities by housing transport, utilities, parking, and storage below ground, freeing surface land for housing, green spaces and other public use.

"There is a need for harmony between surface and underground facilities. Cities must plan the subsurface as an integral part of urban space, considering environment, water, safety, and future uses from the outset. Treating underground infrastructure as an afterthought only creates conflict, risk, and long-term urban failure," Goel says.

Needed a deeper vision

GIFT City (Gujarat International Finance Tec-City) near Gandhinagar, Gujarat is an example of what coordinated planning under a single city-level authority can achieve. While it does not have a dedicated underground master plan, the greenfield development has integrated underground infrastructure into its overall master plan. This includes a multi-utility tunnel stretching over 16 km that houses power, water, sewage, telecom, district cooling and waste systems, allowing most services to operate without repeated road digging. The tunnel network is managed through a central SCADA system that monitors and controls services in real time.

"The tunnel has solved a chronic problem Indian cities face-the constant digging up of roads and built-up areas for repairs and utility upgrades," says Anil Parmar, vice president (engineering) at GIFT City. "The tunnel is up to 8 m wide and 11 m deep, large enough for a small maintenance vehicle to pass through. We regularly receive officials from state governments and municipal corporations across the country who come to study how it works. But this model can be practically implemented effectively only in greenfield cities."

So, what is a realistic first step for legacy cities like Delhi or Mumbai?

"The priority must be comprehensive subsurface mapping and data integration," says Kukreja. This, he adds, includes three-dimensional mapping of utilities, geology, groundwater, and existing underground structures, shared across agencies. "Once a common knowledge base exists, governance mechanisms, regulations, and underground master plans can evolve meaningfully. Without data and integration, any regulatory framework will remain superficial."

Rastogi agrees, saying "India also needs a national subsurface database, made mandatory for building approvals."

That need becomes more urgent as cities densify and spread, says AK Jain, Former Commissioner (Planning) at the DDA (Delhi Development Authority), "There is nothing wrong with cities digging deeper to accommodate growth – it is even desirable. But they must now develop dedicated subsurface master plans to ensure underground space is used safely, efficiently and sustainably."

Source: Excerpts from the News item (Prepared by Manoj Sharma)
Hindustan Times, 12.01.2026

Norway is building the world's deepest and longest road tunnel below the sea

Norway is going on with a massive transport project that, while mostly invisible to the public, is significant in scope. Deep beneath the North Sea, work continues Rogfast, an undersea road tunnel that will be part of a ferry-free route along the country's western coastline. The tunnel is already being cut through solid rock and will eventually span over 27 km, reaching depths of nearly 400 m below sea level. Once completed, it is planned to cut travel times between major cities and lessen dependency on weather-prone ferry crossings. CNN, which has closely monitored the tunnel's progress, has reported on the project's technical requirements and lengthy schedule. The project also showcases Norway's engineering ambition, safety standards, environmental planning, and long-term infrastructure investment priorities for future generations nationwide.

'Rogfast' is short for Rogaland fastforbindelse, named after the region, it serves and the Norwegian term for a fixed link. The tunnel will connect Randaberg and Bokn, forming part of the E39 coastal highway. This road runs for more than 1,100 km from Trondheim in the north to Kristiansand in the south. Today, drivers must board seven ferries to complete the journey. The long-term plan is to remove those crossings through a mix of tunnels and bridges. Rogfast is one of the most complex sections of that plan and one of the first to take shape underground.

At its deepest point, Rogfast will be approximately 392 m below sea level. This makes it significantly deeper than existing submarine tunnels used for automotive or rail transportation. According to CNN, engineers are excavating the tunnel from both ends at the same time, with teams operating in tandem beneath the seabed. The goal is to achieve an error margin of fewer than five cm. This level of accuracy saves money and prevents costly mistakes, especially given the amount of rock being removed.

Precision work at this depth relies heavily on measurement technology. As reported by CNN, laser scanners are used to record newly excavated sections of the tunnel, capturing millions of data points every second. These measurements create a digital model that is compared against design plans. Burkhard Boeckem, chief technology officer at Hexagon, the company providing measurement systems, told CNN that even small deviations can lead to large increases in material handling. Correcting mistakes underground often means removing more rock and then reinforcing the structure again, which adds time and cost.

Working hundreds of metre below sea level brings constant pressure from the surrounding rock and seawater. One of the main technical challenges has been sealing cracks in the rock to prevent saltwater from leaking into the tunnel. Anne Brit Moen, a project manager at Skanska, which is building the northern section of Rogfast, told CNN that water ingress has already occurred during excavation. She said the team is focused on improving grouting methods to maintain safe working conditions as the tunnel goes deeper. The northern section alone is about 9 km long and includes the deepest parts of the route.

Rogfast will consist of two separate tubes, each carrying two lanes of traffic. About halfway along the tunnel, drivers will pass through a double roundabout located roughly 260 m below sea level. This underground junction connects to a branch tunnel leading to the island of Kvitsoy, Norway's smallest municipality. Air quality inside the tunnel is another priority. The design includes a longitudinal ventilation system supported by ventilation shafts. CNN reports that real-time monitoring systems, cameras, and radar will also be used to detect incidents and manage traffic flow.

Rogfast's construction commenced in 2018, but it was suspended in 2019 because of anticipated cost overruns. Work resumed in 2021 following the restructuring, and completion is now

anticipated for 2033. The estimated cost is approximately 25 billion Norwegian kroner, which is equivalent to approximately 2.4 billion US dollars. Moen stated to CNN that enhanced road access will support other forms of employment, education, and public services, despite the likely decline in ferry jobs over time. Additionally, industries such as marine processing are anticipated to benefit from reduced transportation expenses. The tunnel is expected to have a gradual impact, altering daily routines rather than causing an abrupt change.

Source: Times of India, 26.01.2026

Rethinking tunnel design for a sustainable future

Today's tunnelling projects often rely on cast-in-place (CIP) concrete and heavy lining structures. While traditional, these approaches increase cost, excavation volume, construction time, and CO_2 emissions. The possibility of using permanently sprayed concrete allows the preliminary lining to carry permanent loads.

Three solutions can be considered:
- The preliminary sprayed fibre reinforced concrete (FRC) lining collaborating with the cast final lining.
- The preliminary sprayed FRC collaborating with a second-stage sprayed lining.
- The preliminary FRC lining functions as the final stage.

The smarter way: A 74% reduction in CO_2

A more efficient path is available. Replacing both the temporary shotcrete liner and the permanent CIP liner with a single permanent fiber reinforced shotcrete liner, supported by optimized mix designs, can reduce CO_2 emissions by up to 74%. This is not a future concept; it is achievable today.

Why it matters: the Dramix® advantage

Dramix® fiber-reinforced sprayed concrete delivers concrete savings that support the adoption of permanent sprayed concrete.
- Sustainability: Lower emissions through reduced concrete volume.
- Efficiency: Faster construction cycles and smarter design.
- Performance: Durable, high-quality tunnel linings.

Bekaert believes the future of tunnelling depends on smart, sustainable solutions, and Dramix® is driving the shift toward low-carbon, high-performance linings.

Case study: REM metro project (Montreal, Canada)

Infrastructure projects such as the REM Metro demonstrate these advantages:
- Major CO_2 reductions by replacing rebar with steel fibers.
- Thinner, durable linings with extended service life.
- Lower costs through reduced steel and eliminated in-situ installation.
- Faster construction with no formwork.
- High safety based on clear performance criteria and testing.

Source: Excerpts from ITA News # 81, 8.4.2026

Hagerbach test gallery - latest developments in research and innovation

One year after its recognition as a Research Infrastructure of National Importance in Switzerland, the Hagerbach Test Gallery (VSH), the Underground Future Lab, has significantly strengthened its ties to academia. Jointly with partners from industry, research consortia including VSH and other higher education institutions are active in diverse activities such as smart cities, heavy construction and operation, energy, and digital twin.

Profiting from stable temperature conditions, absence of pesticides, and available existing caverns, a research project with the objective of assessing necessary conditions and requirements for salad production underground has been launched. A second project investigates possible underground storage of a hydrochar obtained via a carbonization process of wet biomass in view of carbon dioxide removal from the atmosphere. In the area of concrete technology, a camera-based measurement system of the gradation curve will deliver innovative solutions regarding production optimization.

In the mentioned projects, VSH collaborates as a research partner with highly reputed institutions, such as the Swiss Federal Laboratories for Materials Science and Technology (Empa), the Zurich University of Applied Sciences (ZHAW), and the University of Applied Sciences Eastern Switzerland (OST). Furthermore, ten scientific proposals, with VSH as one of several national and international research partners, are currently under review, demonstrating the relevance of the unique infrastructure for addressing future societal challenges.

In parallel, VSH has installed a scientific council. This body, composed of world-renowned experts from academia, has the goal to support VSH in its future reorientation towards closer collaboration with higher education institutions. Their engagement provides consulting around relevant scientific topics and an academic network. Jointly with the Hagerbach foundation, in charge of governing the public funds for infrastructure upgrading of the gallery, the VSH team is actively transforming VSH into an underground research facility of the future. As a continuation of the traditional line of activity, VSH is active in ITA-AITES at various levels in organization, working groups, and committee work, and pushed Technology and Training efforts to strengthen quality, safety, and sustainable underground works.

(Dr. R.K. Goel, Former Chief Scientist, CSIR-CIMFR, & Editor, JRMTT, believes that abandoned underground mines and/or mined-out underground spaces in India could be effectively utilized for several strategic and societal purposes. He further suggested that collaborative research and development initiatives may be undertaken in partnership with mining companies, such as Coal India Limited, Hindustan Zinc Limited, and similar organizations, to explore and implement these applications.)

Source: ITA News # 81, 9.4.2026

IIT-Bombay and NTPC lead India's push towards large-scale carbon storage

In a boost to India's clean-energy and climate action efforts, NTPC and IIT-Bombay have completed drilling the country's first geological well in Jharkhand to test the feasibility of underground carbon dioxide (CO_2) storage. The drilling of a second well in the vicinity has also commenced on Dec 21, primarily to monitor and study the behaviour of injected CO_2 and its containment using multiple monitoring techniques. The success of the drilling project marks an important step in academia-industry collaboration in carbon Capture, utilization, and Storage (CCUS) and will also position the country closer to developing indigenous, large-scale solutions for reducing carbon emissions. IIT-Bombay is the implementation agency for the project.

The collaboration, facilitated by NITI Aayog, in Nov 2022, brought together the R&D wing of NTPC, and the Department of Earth Sciences, IIT-Bombay in building India's first geological storage atlas for coalbed methane-rich coalfields. In Sept 2025, they commenced the country's first drilling in Hazaribagh to a depth of 1,200 m, for potential CO_2 storage around a coal mining area, and completed it last month. Studies are underway to check the potential of drilling such wells in many other regions, including Mumbai High.

The project will generate detailed feasibility and risk assessments for full-scale carbon capture and storage (CCS) development, including a commercial deployment plan. Preliminary studies indicate significant storage potential in the North Karanpura coalfield, with the Pakri-Barwadih block alone estimated to accommodate up to 15.5 million tons of CO_2 over a 10-year injection period, said Prof Vikram Vishal, project lead from IIT-Bombay. Explaining the need for the initiative, Prof Vikram told TOI, "India produces roughly 2.95 billion tonnes of CO_2 annually, and almost a third of it comes from the power sector. As India pursues its net-zero ambitions, certain sectors will continue to emit CO_2 due to the very nature of their industrial processes. While renewable energy, hydrogen, and other clean technologies will play a crucial role in reducing emissions, they cannot eliminate process-related CO_2 emissions. Capturing this carbon is part of the solution. While conversion into useful chemicals is limited by market demand and scale, at the volumes India is likely to deal with, geological storage becomes unavoidable. Storing CO_2 deep underground is therefore essential for industries and the country as a whole."

Prof Shireesh Kedare, Director, IIT-Bombay, celebrating the landmark contribution, emphasized the role of translational research in architecting the roadmap for India's energy transition and decarbonization.

- Yogita Rao
Source: Times of India, 30.12.2025

Indian-origin scientist wins 'Nobel of Geosciences' prize

Indian-origin climate scientist Veerabhadran Ramanathan has been awarded the 2026 Crafoord Prize in Geosciences by the Royal Swedish Academy of Sciences. Often described as the "Nobel of Geosciences," the prize recognizes Ramanathan's decades of research on super-pollutants and atmospheric brown clouds, which have reshaped understanding of global warming.

Ramanathan, 82, made a landmark discovery in 1975 while working at Nasa: chlorofluorocarbons (CFCs), widely used in aerosols and refrigeration, trap heat in the atmosphere up to 10,000 times more effectively than carbon dioxide. "Until 1975, we thought global warming was mainly from CO_2. I was shocked at the capacity of technology and human beings to change the environment," Ramanathan told the Royal Swedish Academy of Sciences.

Born in Madurai and raised in Chennai, Ramanathan began his career as an engineer in Secunderabad, where he first handled CFCs. He later earned degrees from Annamalai University and the Indian Institute of Science. His Indian roots informed his work in the Indian Ocean Experiment (INDOEX), which identified atmospheric brown clouds over South Asia. Now, a distinguished professor emeritus at the Scripps Institution of Oceanography, University of California, San Diego, he has also advised global leaders and the Vatican on climate ethics.

Source: NDTV & The Times of India, 02.02.2026

Workshop on "Modern Tunnelling Techniques" Organized by ISRMTT in Association with NGI Norway and CSMRS, New Delhi

A one-day workshop on "Modern Tunnelling Techniques" was successfully organized on 17th April 2026 at the India International Centre, New Delhi. The event was jointly conducted by the Indian Society for Rock Mechanics and Tunnelling Technology (ISRMTT) in association with Central Soil and Materials Research Station (CSMRS), New Delhi, and Norwegian Geotechnical Institute (NGI), Norway. The workshop brought together experts, practitioners, and researchers from across the country to deliberate on recent advancements and best practices being adopted in Tunnel engineering. The program began with a welcome address by Dr. Rajinder Bhasin, Technical Expert, Rock Engineering, NGI, Norway & President, ISRMTT, who underscored the vital role of modern tunnelling technologies in advancing infrastructure development, particularly within the complex geological environment of the Himalayan region.

The technical sessions featured six informative lectures delivered by distinguished professionals from India and Norway, which was followed by technical discussions. Four technical lectures were conducted during the pre-lunch session. In the first lecture, Mr. Vebjørn Røvde, NGI, Norway, presented notable examples of modern tunnelling practices adopted in Norway, highlighting innovative methodologies and international experiences in underground construction. The second lecture was delivered by Er. Sumit Jain, Project Director, RVNL, who discussed the application of advanced technologies, including Tunnel Boring Machines (TBMs), in the successful execution of the twin tunnels of the Rishikesh-Karnaprayag Rail Project, with particular emphasis on the engineering challenges and solutions associated with the TBM application in the Lower Himalayan region.

The third lecture by Mr. Arnstein Aarset, NGI, Norway, elaborated on the digitalization of tunnel construction practices at Norwegian tunnel sites, emphasizing the role of digital technologies in improving construction efficiency, monitoring, and safety. In the fourth lecture, Dr. Sanjay Rana, Managing Director, Parsan Overseas (P) Limited and an active geophysicist in India, discussed the application of geophysical techniques for achieving safe and sustainable construction practices.

There were two lectures in the post-lunch session. The first lecture after lunch was delivered by Dr. Rajinder Bhasin, who discussed the principles, mechanisms, and functioning of Reinforced Ribs of Shotcrete (RRS) as an effective tunnel support system. His presentation was enriched with relevant case studies demonstrating the practical application of RRS in underground excavations. Subsequently, Dr. R. K. Goel, a distinguished rock engineering consultant and Editor of JRMTT, presented an informative lecture on improving rock mass quality around tunnel peripheries using full-column grouted rock bolt supports. His talk offered valuable practical insights into the design, application, and performance of underground support systems.

The sessions were followed by an engaging technical discussion led by Dr. Rajbal Singh and Mr. Haridev, allowing participants to interact with the speakers and exchange ideas. The workshop concluded with a vote of thanks by Mr. Haridev, the Immediate Past President of ISRMTT. The event witnessed active participation from engineers, academicians, researchers and students, reflecting the growing interest in advanced tunnelling technologies in India. The workshop served as an effective platform for knowledge sharing and professional interaction, contributing to the advancement of tunnelling practices in the country. Participants emphasized having such programs at frequent intervals.

– Editors

A Rare Conversation Between Ramkrishna Paramhansa & Swami Vivekananda

*(The relationship between Ramakrishna Paramhansa and Swami Vivekananda is widely considered one of the most significant **Guru-shishya** (teacher-disciple) bonds in modern spiritual history. Ramakrishna was the master who provided Vivekananda with direct spiritual experience, while Vivekananda became the vehicle for spreading Ramakrishna's message globally)*

Swami Vivekananda (SV): *I can't find free time. Life has become hectic.*
Ramkrishna Paramhansa (RP): Activity gets you busy. But productivity gets you free.

SV: *Why has life become complicated now?*

RP: Stop analyzing life... It makes it complicated. Just live it.

SV: *Why are we then constantly unhappy?*

RP: Worrying has become your habit. That's why you are not happy.

SV: *Why do good people always suffer?*

RP: Diamond cannot be polished without friction. Gold cannot be purified without fire. Good people go through trials, but don't suffer. With that experience, their life becomes better, not bitter.

SV: *You mean to say such experience is useful?*

RP: Yes. In every term, Experience is a hard teacher. She gives the test first and the lessons later.

SV: *Because of so many problems, we don't know where we are heading…*

RP: If you look outside, you will not know where you are heading. Look inside. Eyes provide sight. Heart provides the way.

SV: *Does failure hurt more than moving in the right direction?*

RP: Success is a measure as decided by others. Satisfaction is a measure as decided by you.

SV: *In tough times, how do you stay motivated?*
RP: Always look at how far you have come rather than how far you have to go. Always count your blessings, not what you are missing.

SV: *What surprises you about people?*

RP: When they suffer, they ask, "Why me?" When they prosper, they never ask "Why me?"

SV: *How can I get the best out of life?*

RP: Face your past without regret. Handle your present with confidence. Prepare for the future without fear.

SV: *One last question. Sometimes I feel my prayers are not answered.*

RP: There are no unanswered prayers. Keep the faith and drop the fear. Life is a mystery to solve, not a problem to resolve. Trust me.

Source: The Gospel of Shri Ramkrishna Paramhansa

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Available online at www.isrmtt.com

Pioneering Thoughts

This issue is dedicated to the visionaries whose blissful pursuit of greatness continues to inspire us all.

- God is discovered entirely through creation – the brilliance of a sunset, the powerful roar of a waterfall, the symphony of sounds you hear in the heart of the forest, or the vastness of space and its countless stars.

- Benjamin Sullivan

- The man who moves a mountain begins by carrying away small stones.

- Lao Tzu

- Do what you can, with what you have, where you are.

- Theodore Roosevelt

- Keep playing until they get it right.

- Billie Jean King

- We are what we repeatedly do. Excellence, then, is not an act, but a habit.

- Aristotle

- Life is 10% what happens to you and 90% how you react to it.

- Charles R. Swindoll

- The person who follows the crowd will usually go no further than the crowd. The person who walks alone is likely to find himself in places no one has ever seen before.

- Albert Einstein

- All our dreams can come true, if we have the courage to pursue them.

- Walt Disney

- I alone cannot change the world, but I can cast a stone across the waters to create many ripples.

- Mother Teresa

- I have not failed. I've just found 10,000 ways that won't work.

- Thomas Edison

- We only know a tiny proportion of the complexity of the natural world. Wherever you look, there are still things we don't know about and don't understand. [...] There are always new things to find out if you go looking for them.

- David Attenborough

- There is not a right and a wrong answer to every question.

- Dallin H. Oaks

Journal of Rock Mechanics and Tunnelling Technology (JRMTT)
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To Readers

Experienced engineers and researchers are invited to share their insights on the practical applications of Rock Mechanics and Tunnelling Technology for publication in the 'News & Views' section of the Journal. Submissions should remain within 150 words and reflect original content drawn from personal experiences in their professional careers. Contributors' names will be acknowledged in the journal.

Students, researchers, and engineers are also encouraged to submit abstracts of their Ph.D. theses, news of general interest, and inspiring quotations with their sources for publication under "Abstract of Ph.D. Theses," "News & Views," and "Pioneering Thoughts" respectively. Acknowledgment will be given to all contributors.

To foster a deeper understanding, we invite practicing engineers, geologists, and researchers to send in their questions or requests for clarifications about the empirical theories, concepts, correlations, case histories etc. presented in the papers published in JRMTT. These questions will be forwarded to the authors for their insights. Please be aware that the cutoff for submitting additional comments and information on the published research papers is two years from their publication date. The authors' responses will be included in the 'Discussions: *Research and Practice Interface*' section of upcoming JRMTT editions.

- Editors
JRMTT

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AIMS AND SCOPE

- Journal of Rock Mechanics and Tunnelling Technology (JRMTT), founded in 1992, invites both original research and review manuscripts addressing various theoretical and practical aspects of rock mechanics, tunnelling technology, engineering geology, and mining. The Journal covers a wide range of topics, including shallow and deep underground civil and mining structures, tunnelling through different rock mass conditions and rock and soil mass behaviour related to natural and engineered slopes.

- JRMTT also welcome submissions on rock engineering, geological and geotechnical site investigations, laboratory studies, and various stabilization techniques related to tunnel and slope engineering and mining.

- Manuscripts that explore new and emerging topics in rock mechanics, tunnelling technologies, mining and engineering geology are particularly encouraged.

- JRMTT especially value practical and field-oriented contributions.

- Book reviews, interviews and views/commentaries etc may also be included for publication if found suitable by the Editors.

- Manuscripts/ technical notes submitted to the Journal must not simultaneously be under review by other journals.

- Any statements or views presented in the Journal would be totally those of the authors and shall neither be moderated nor reversed by the Editors of JRMTT. The contents of the journal are contributions of authors, and reflect their independent opinions, findings, conclusions and recommendations and do not necessarily imply that they reflect the views of the publisher/ editorial board.

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This should have only the title of the article / technical note, the author's name, institution of origin with its address (including email address), abstract, keywords, text, and necessary footnotes, if any.

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Example: Anisotropic; Foliation joints; Deformation modulus; Uniaxial jacking tests.

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Equations and formulae must be set up clearly and should be typed using Cambria Math in 12 pt. Numbers identifying equations should be in brackets and placed flush with the left margin of the text.

Example: $E_d = \frac{P_m(1-\vartheta^2)}{\delta\sqrt{A}}$ *(1)*

PHOTOGRAPHS, FIGURES, AND LINE DIAGRAMS

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Journal Articles

Mitra Subhash, Singh Bhawani (1997). Influence of geological features on long-term behaviour of underground powerhouse cavities in the lower Himalayan region: a case study. Journal of Rock Mechanics and Tunnelling Technology, 3(1):23-76.

Neuzil CE and Pollock DW (1983). Erosional unloading and fluid pressure in hydraulically tight rocks. Journal of Geology, 91:179-193.

Article by DOI*

Dwivedi RD, Goel RK, Prasad VVR, Sinha A (2008). Thermo-mechanical properties of Indian and other granites. Int J Rock Mech Min Sci, https://doi.org/10.1016/j.ijrmms.2007.05.008
(**DOI format shall be used if only Vol. and Page numbers of the article are unavailable*)

Book

Goel RK, Singh Bhawani, Zhao Jian (2012). Underground Infrastructures: Planning, Design and Construction, Elsevier Inc., USA, 334p.

Book Chapter

Harrison JP, Hudson JA, Popescu ME (2002). Strain and the theory of elasticity. In: Engineering Rock Mechanics: Illustrative Worked Examples, Part 2, Pergamon, 65-82.

Goel RK, Singh B (2017). Tunnels in the Himalaya. In: Rock Mechanics and Engineering, CRC Press, Vol. 5, 69-108.

Conference Proceeding

Hoek E, Carter TG, Diederichs MS (2013). Quantification of the geological strength index chart. In: Proc ARMA US Rock Mechanics/Geomechanics Symposium, 208-213.

Bhasin Rajinder, Thomas P (2013). Dynamic analysis of rock support in tunnels with a case study of a large underground cavern in the Himalayas: Keynote Lecture. In: Proc 4th Indian Rock Conference Indorock'2013, May, Solan, India, 77-89.

Ph.D. Thesis / Dissertation

Mitra S (1991). Study on Long-term Behaviour of Underground Powerhouse Cavities in Soft Rocks. Ph.D. Thesis, Department of Civil Engineering, University of Roorkee (now IIT Roorkee), India, 193p.

Online Document

Lanzano G, Bilotta E, Russo G (2008). Tunnels under seismic loading: a review of damage case histories and protection method (www.reluis.it/doc/pdf/Pubblicazioni/Lanzano-Bilotta-Russo.pdf), Downloaded in April 2013.

Reports

CSMRS (2016). Report on deformability characteristics of rock mass by uniaxial jacking tests in right bank drift D-2 at dam site of Pancheshwar Multipurpose Project, India / Nepal, CSMRS, New Delhi, 27p.

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