

Delhi Metro Railway Going Full Steam Ahead

With the arrival here in bits and pieces of three giant tunnel boring machines for construction of an 11-km underground corridor, the upcoming Delhi Metro rail project has now entered its most crucial phase. Of German Herrenknecht make, each machine costing about Rs. 40 crores weighs around 500 tonnes.

While two of these have been used in the construction of the Bangkok Metro and later retrofitted to suit Delhi's soil conditions, the third meant for hard rock terrain is coming straight from Germany. The machines are being brought in knock-down kits in about 60 containers.

“While transportation of these machines - whose single largest piece, the culling head, itself weighs 130 tonnes - is a big task, lowering these through shafts to the track level would require an even more Herculean effort. To lower these, we need 450 tonnes cranes mounted on concrete platforms. The TBMs, which have a 6.2 m diameter, would be assembled at the base. And with a force of 2,000 tonnes they would move forward at an average speed of 250 metres/month or about 8 metres per day”, says the Chief Project Manager for metro Corridor of the Delhi Metro Rail Corporation.

By excavating in “positive pressure” at a depth of 6 to 14 metres underground, the TBMs prevent unnecessary movement of earth. As they move forth, side-walls are simultaneously formed with 1.2 metre-long pre-cast concrete slabs, seven of which form a ring.

Source : The Hindu, May 22, 2002

Nathpa Jhakri Power Project Nearing Completion

Power-starved north India is in for a brief respite as most of the civil construction works of the 1,500 MW Nathpa Jhakri Power Project are nearing completion. The project is being constructed by Nathpa Jhakri Power Corporation in North Indian State of Himachal Pradesh.

Two of the six 250 MW units are likely to be commissioned in early 2003 adding 500 MW electricity in the northern grid. The other four units of 250 MW capacity each would also be commissioned later.

A joint venture of the Union and Himachal Pradesh governments, both sharing the equity in the ratio of 75:25, the project is funded by the World Bank to the tune of \$437 million. The balance requirement would be funded by the European banks and Power Finance Corporation and commercial banks.

In the dam complex, concreting has mostly been completed while the excavations of the desilting chambers is in an advanced stage of completion.

The 57 m-high dam of the project is designed to divert 486 cusecs of Satlej water into the 27.39 km stretch of Head Race Tunnel (HRT) through four intakes. To arrest the sediment flowing into the HRT, the water will pass through four desilting chambers - a system which is one of the largest among the underground chambers in the world, which will house six units of 250 MW each. All the civil construction work of the underground power house complex - save a few architectural works have been completed. In the three pressure shafts, steel lining with backfill concreting has also been completed.

Source : The Times of India, April 26, 2002

Peak Ground Acceleration During Major Earthquakes

The earthquake of magnitude 8.0 may not cause higher peak ground acceleration than that of an earthquake of magnitude 6.5. However, the duration of strong ground shaking of a larger earthquake will be longer. The basic (defensive) seismic design aspects of large embankment dams are liberal free-board, increase of crest width and flattening of slopes etc. The seismic design criteria for large dams have changed. It is time to look also into the seismic safety of the existing large dams.

Source : Wieland, M. (2001). Discussion on Fail-safe Large Dams in Earthquake Prone Himalayan Region, ISETJ, Earthquake Technology, Vol.38, No.1, p.57.

Power Station that Runs on Tidal Currents

In a novel use of clean energy, the world's most northerly town will soon be the first to get electricity from a sub-sea power station run on tidal currents tugged by the moon.

Gigantic forces in the oceans - waves, currents and tides - have often proved too costly or awkward to harness, compared to wind or solar power in global efforts to cut reliance on nuclear power or on fossil fuels blamed for global warming. Starting in late November or early December of 2002, however, a tidal current will start turning the blades of a windmill-like turbine standing on the sea-bed near Kvalsund at the Arctic tip of Norway.

"We will be the first in the world to use tidal currents to generate electricity to be fed into the local grid," Harald Johansen, Managing Director of Hammerfest Stroem, said.

Other unorthodox sub-sea experiments to generate power from tidal currents from Australia to Britain have not gotten to the stage of selling power.

Tides have previously been tapped for use in power plants in France, Canada and Russia by building barrages to trap water in artificial lagoons at high tide.

But giant damming projects are out of fashion because they can damage the ecology of rivers and coastlines. Seabed turbines, by contrast, are silent and invisible and fish can swim around them without getting sliced up.

“Of all the renewable energy technologies, ocean energy is probably the one in the earliest stages,” said Mark Hammonds at the International Energy Agency (IEA) in Paris. “Many projects have proved to be too costly.”

Tidal power exploits the gravitational pull of the moon, and to a lesser extent the sun, on the oceans as the earth spins. The seas rise and fall in a cycle of 12 hours and 25 minutes and can cause sweeping currents along the seabed at the same time, like the ones seen off the north Norway coast.

The Norwegian sub sea turbine will have a tiny capacity of 300 kilowatts and is due to expand to 20 mills from 2004.

Source : The Times of India, Nov. 8, 2002

Rock Signals may Forecast Earthquakes

Japanese seismologists believe they have confirmed a controversial technique, measuring electro-magnetic signals from rocks, that hopes to predict when and where earthquakes will occur and how destructive they will be.

The method was first expounded by a trio of Greek scientists five years ago, who suggested that rocks being ground together under immense stress emit telltale electrical waves and magnetic pulses.

But many experts have been scornful because, until now, no one has been able to replicate their results.

But Tokai University’s Earthquake Prediction Research Centre say they now have data to back the Greeks’ claims, the British weekly New Scientist reports.

Using telephone wires as antennae, they spotted anomalous changes in electromagnetic waves in Japan’s Izu islands in March 2000.

These waves, in the extremely low part of the energy spectrum, grew steadily until, three months later, a series of earthquakes occurred. The signals peaked just before the first large quake, measuring 6.4 on the Richter scale, occurred on July 1. When the quakes died away, so did the waves.

Source : The Times of India, June 13, 2002

Some New Q-value Correlations to Assist in Site Characterisation and Tunnel Design

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The rock mass quality Q-value was originally developed to assist in the empirical design of tunnel and cavern reinforcement and support, but it has been used for several other tasks in rock engineering in recent years. This paper explores the application of Q and its six component parameters, for prediction, correlation and extrapolation of site investigation data, and for obtaining first estimates of some input data for both jointed distinct element and continuum-approximation modelling. Parameters explored here include P-wave velocity, static modulus of deformation, support pressure, tunnel deformation, Lugeon-value, and the possible cohesive and frictional strength of rock masses, undisturbed, or as affected by underground excavation. The paper concludes with an evaluation of the potential improvements in rock mass properties and reduced support needs that can be expected from state-of-the-art pre-injection with fine, cementitious multi-grouts, based on measurements of permeability tensor principal value rotations and reductions, caused by grout penetration of the least favourable joint sets. Several slightly improved Q-parameter ratings form the basis of the predicted improvements in general rock mass properties that can be achieved by pre-grouting. (*Experience of research in India is also considered.*)

*Source : Int. J. Rock Mechanics and Mining Sources,
Vol.39, 2002, pp. 185-216
(Abstract of the Research Paper)*

‘Chunnel’ for Kolkata, India

The twin cities of Howrah and Kolkata could soon boast of a miniature version of the ‘Chunnel’, an underwater tunnel that connects Dover in England to Calais in France.

The project, still at a conceptual stage, envisages tram services through a tunnel passing under the Hooghly river, connecting its two banks. If the dream project does materialise, Kolkata will be the first city in the country to have such a system. The city already boasts of the first underground railway in the country and is the only city where the tram still plies.

According to West Bengal transport minister Mr. Subhas Chakraborty, the 3.5 km long dream project that would see tram lines running through a tunnel below the Hooghly bed is estimated to cost under Rs. 300 crore, much lower than the cost of constructing a bridge across the river.

Source : The Times of India, May 23, 2002

Biocement Grows in Strength

A cement that uses bacteria to create its binding agent may someday help repair the Netherlands' famed dikes. According to Vicky Whiffin - a researcher at Murdoch University, Perth, Australia, who is conducting experiments on the biological cement, or biocement - the technology holds great promise and may make it possible to carry out efficient in situ repairs on such porous building materials as sandstone.

Whiffin's research examines the capability of the bacteria genera *Bacillus* and *Proteus* to produce an enzyme that in the presence of the right substrate forms carbonate ions. When calcium ions are present in this reaction, calcite crystals, such as those that make up limestone, are formed. In a porous material such as limestone or sandstone, the calcite crystals link the material's individual grains, thereby imparting strength. In looser particles (sand), the process can form a solid block of material.

"Natural sand stones take five hundred to a thousand million years to form, whereas we can make something that is essentially the same as natural sandstone in a few days" says Whiffin. The components of the biocement are aqueous and can be applied by irrigating or flooding the desired material to be strengthened. "Because the treated material remains porous after treatment, additional treatments can be applied to increase strength," says Whiffin. Ultimately, strengths comparable to those of foundation concrete can be achieved, she says.

Although the technology can be applied to any material that is porous, materials with significant clay content do not lend themselves to the process because their hydrophobic properties make them difficult to penetrate. The biocement approach offers a number of advantages over such traditional repair methods as using injectable grouts or patching structural weaknesses with cement.

"If these materials are patched with concrete, which has a lower porosity, moisture can't move through the patched area as quickly as it moves through the existing sandstone. Consequently moisture builds up behind the patch and causes it to detach from the structure. The big advantage of this technology is that you can infiltrate the components into the material, which results in deeper penetration and a more homogeneous and product," says Whiffin. The biocement is ideal for restoring monuments and buildings of historical importance because many of these structures are constructed of sandstone and limestone.

*Source : Civil Engineering, August 2002, volume 72, Number 8
(IEI News, Nov. 2002)*

Indo-Russian Mission to Explore Gas Hydrates

India and Russia together will embark on a mission to explore and excavate gas hydrates - an alternative fuel resource - in the Arabian Sea and the Bay of Bengal.

The mission was finalised in Bangalore as part of the Indo-Russian Integrated Long Term Programme (ILTP) in science and technology. Speaking to mediapersons on Thursday after the conclusion of the 11th session of the Indo-Russian Joint Council of the ILTP, CNR Rao - who heads the Indian delegation -said preliminary surveys along the country's 7500 km coastline had been completed.

"There are billions of tonnes of gas hydrates. We know the spots where hydrates are present. But only with prospecting, will we be able to estimate the concentration," he said.

India has gas hydrate reserves near Goa, Kochi and Kolkata and other spots along the Arabian Sea and the Bay of Bengal at depths varying from 400 m to 2 km. Funding required in the initial stage of the project could be to the tune of 50-100 crore, but a major investment running to thousands of crores would be needed for extraction. Commercialisation could take 10 years.

An Indo-Russian Centre for Gas Hydrate Studies will be set up in Chennai at the Indian Institute of Oceanography to decide on the technology to be used for recovery, purification and transportation of gas from the hydrate deposits. The Indian Government will also work out the economics of exploitation. Ocean floors will be probed to assess the quantity of deposits.

Gas hydrate is a crystalline solid formed by highly concentrated methane trapped in water in the form of ice.

The presence of such hydrates was discovered on 1960s. Gas hydrate is said to contain more organic carbon - about 10,000 billion tonnes - than all other global hydrocarbon reserves - 8780 billion tonnes. Gas hydrates provide an eco-friendly fuel option. So far, only Russians have successfully explored the possibility of the resource in West Siberia. Canada and Japan are two other countries researching this concept.

Source : The Times of India, Nov. 9, 2002

Book on Software for Engineering Control of Landslide and Tunnelling Hazards

The book authored by Prof. Bhawani Singh and Dr. R. K. Goel and published by A.A. Balkema, The Netherlands offers solutions to problems of hazard

control of landslides in highly fragile areas and tunnels in complex geological formations. It is complementary to authors' book on Rock Mass Classification.

Chapters on practical knowledge of both landslide and tunnelling hazards and behaviour of rock joints and rock masses are presented for preparation of realistic input data. The emphasis is on proper design of remedial measures and not on rigorous analysis. There are 18 practical and field-tested software packages on landslide in soil and rock and 6 packages on tunnels along with source programs, user manuals and solved examples.

The book serves both the academic and professional civil and mining engineering communities, and is also an excellent tool for those working and studying in the field of engineering geology.

- *Editors*

A World Water Poverty Index

A new Water Poverty Index (WPI) developed to highlight the differences between water-rich and water-poor nations will be the cornerstone of the Third Water Forum in the Japanese city of Kyoto next March.

The Index, developed by a team of researchers at Britain's Centre for Ecology and Hydrology and experts from the World Water Council, was unveiled ahead of the international Year of Freshwater.

Out of a total of 147 countries, it ranks Finland on top followed by Canada, Iceland, Norway, Guyana, Suriname, Austria, Ireland, Sweden and Switzerland. Not surprisingly, almost all the most water-rich nations are in the northern hemisphere and almost all those with the least water are in Africa. But, in a departure from usual practice, the researchers did not only use access to good quality water as their benchmark. They took five different criteria to construct their index - resource, access, use, capacity and environment.

Research team leader Caroline Sullivan said this explained why rich nations like the United States ranked a relatively lowly 33rd while developing nations such as Guyana and Suriname came in at fifth and sixth respectively. The International Water Poverty Index demonstrates that it is not the amount of water resources available that determine poverty levels in a country, but the effectiveness of how you use those resources. The links between poverty, social deprivation, environmental integrity, water availability and health becomes clearer in the WPI, enabling policy makers to identify where problems exist and the appropriate measures to deal with their causes".

Experts calculate that 20 percent of the world's population in a total of 30 countries faced water shortages in 2000, a figure expected to climb to 30 percent or 2.3 billion people in a total of 50 countries by 2025.

It is a commitment due to be turned into concrete plans on March 22 at the Kyoto meeting which is already being flagged as likely to be the most important water conference ever held.

Source : The Times of India, Dec. 13, 2002

Powerful Explosive

This kind of explosive is an exotic form of silicon which releases seven times as much energy as TNT and explodes a million times faster. While preparing this kind of explosive, the porous silicon is cooled to the temperature of liquid nitrogen and made to a sponge like material in a vacuum. When oxygen condenses on the sample, oxidation occurs explosively. Porous silicon has a layer of hydrogen just one atom thick covering its surface. This creates a barrier between oxygen and silicon atoms. But when a single hydrogen bond breaks, an oxygen atom can bind to the silicon, starting a chain reaction that rips through the structure. The explosion is violent because oxidising silicon releases a huge amount of energy as compared to conventional explosives. Using liquid oxygen rather than gas means there are lot of oxygen atoms at the silicon surface. Because the silicon is sponge-like, it has a very high surface area to volume ratio and this provides an efficient burn.

Source : Technorama, IE (I), Vol.51 (T), No.2, 2002

Cool Down with a Visit to the Temple !

Feeling totally stressed out ? Or are you again in one of those cantankerous moods, maddened at the material world ? Take this scientific recipe for soothing your nerves - visit a temple !

Going by the arguments put forth by Dr. N. Gopalakrishnan, a scientist with the Council for Scientific and Industrial Research (CSIR), the reasons why a person feels relaxed by visiting a temple can be related to science rather than spirituality.

According to Gopalakrishnan, “All five senses of a person get activated when he visits a temple, energising the body and giving him an immediate sense of relief.”

Delivering a lecture on “scientific analysis of temple rituals” at Veda Bhavan here on Sunday, Gopalakrishnan said, “The positioning of idols in any temple pleases the eyes of the worshipper to the extent that he closes them immediately once he reaches the sanctum sanctorum. And when the eyes close, the bloodflow streamlines, relaxing all the nerves connecting the eye.” Similarly, he said, “when the temple bells toll, conch-shells are blown and

mantras chanted, they together produce a sound energy that strengthens the hearing senses.

“The fresh flowers offered to the deity produces chemical energy, helping the worshipper purify his smelling senses. In the form of prasad, a person gets the minimum seven gram of fructose essential for the functioning of brain. It also improves his taste buds.”

Besides, chandan (sandalwood paste) and tulsi (leaves of an unique herbal plant) applied at the back of an ear increases the blood flow of the worshipper and improves his “sense of touch”. Gopalakrishnan said most temple rituals could be defined in chemistry and physics.

He said, “Pujas are a process of energising the idol by creating electro-magnetic waves around it through pradakshinas (circumambulation) and energy from the electro-magnetic waves could be transformed into ourselves through ekagrata (concentration).”

Source : The Times of India, April 2, 2002

Indian Statistician Rewrites Number Game

What was remarkable about the June 12, 2002 event was not that US President Bush bestowed the President’s National Medal for Science on Calyampudi Rao, but the circumstances in which Rao earned the award. Four other scientists of Indian origin - the physicist Subramaniam “Chandra” Chandrasekhar, the geneticist Hargobind Khorana, Bell Lab’s C Kumar Patel and Arun Netravali - have been honoured thus, but none came into it in the manner of Rao.

Here’s why Calyampudi Rao came to the US in 1980 only after superannuation, having (been) retired at 60 as director of the Indian Statistical Institute (ISI), Kolkata.

Typically, at that age, most Indian elders visit America to play with their NRI grand-children. Rao, too, had his grandchildren - his daughter teaches at Buffalo and his son works for a computer company in Pittsburg - but he had other business to mind.

Following a speaking gig, he was invited to join the statistics faculty at the university of Pittsburg at 62, went on to a chair at Pennsylvania State University at 70, became a US citizen in 1995 at 75, and won presidential laurels at 82. That constituted not just a second academic wind, but a third and fourth one too.

Rao is considered by many as India’s greatest numbers man after the legendary PC Mahalanobis, and was honoured by the government with the Padma Vibhushan, the country’s second highest civilian award.

But what thrills him is how much America has recognised his post-retirement achievements. In a lavish tribute that accompanied the announcement of the award, Penn State University, where he is now attached, said “Rao is internationally acknowledged as one of the pioneers who laid the foundation of modern statistics, as well as one of the world’s top five statisticians.”

His research, scholarship and professional services, the University said, have had a profound influence on the theory and application of statistics in such diverse fields as anthropology, geology, biology, psychology, social sciences and national planning.

Rao’s research in multi-variate analysis, for example, has been used to improve economic planning, weather prediction, medical diagnosis, tracking the movements of spy planes and monitoring the course of spacecrafts.

In citing Prof. Rao for the award, the White House recognised “his pioneering contributions to the foundations of statistical theory and multivariate statistical methodology, and their applications, enriching the physical, biological, mathematical, economic and engineering sciences.”

The medal is the US’ highest award for lifetime achievement in fields of scientific research.

Rao says the award is also recognition of India’s “magnificent legacy” in the field of statistics, the foundation for which was laid by Mahalanobis in 1938 with the setting up of the ISI. He says according to RA Fischer, a renowned statistician with whom Rao trained and earned his Ph.D, a majority of the world’s statisticians today are Indians.

Source : The Times of India, Aug. 18, 2002

