In this issue

Performance of stone columns

COMMON sense dictates that soft soil makes for a weak foundation to build buildings upon. Yet, one bears witness to apartment blocks, marine docks, and even oil tanks – which are brimmed with thousands of tonnes of oil – that stand rooted firm to the otherwise soft soil. *Why doesn't the foundation give way?* The answer lies in a disarming heap of crushed stone.

Indeed, machines, known as vibrators, bore many metres deep into the soft soil, and, by forcing either pressurized air or water through, displace the soil. Then, simultaneously, as the soft soil is displaced, the vibrator probe 'feeds' a granular mixture of crushed stone into the soil. The process is repeated till several layers of crushed stone are heaped atop one another, thus forming a compact column of stones beneath the surface. This column of crushed stones bolsters soil strength, and enhances the load bearing capacity of the ground. Considering how cheap, and efficient these stone columns are, it should come as no surprise that buttressing the ground with stone columns is one of the most common ground improvement strategies used world over. But often, in *very* soft clay soil, there is little that an ordinary stone column can do.

The reason why a stone column is able to maintain its cylindrical structure deep beneath is that the soil itself is able to bind it firm. But when the soil is too soft, then the granular stones from the column simply leaks into the soil, greatly compromising the structural integrity, and hence also the load bearing capacity of the column. So, what does one do to ensure that the stone does not spill into the surrounding soil? Van Impe, in 1989, came up with an intuitive answer: One reinforces the ordinary stone column by wrapping it with a firm material that applies enough radial pressure to keep the stones in place.

It is surprising, however, that even after two decades since their inception into ground, little is known about how *strong* reinforced stone columns are when in a small group. Yes, several research papers have endeavoured to understand the load bearing parameters of these reinforced columns; but all of these studies have dealt with columns that are surrounded not by one or few, but by a whole congregation of stone columns.

Any engineer worth his salt would tell you that the behaviour of a small group of stone columns is very different from a large group of stone columns because in a small group, the peripheral stone columns are subject to loss of lateral confinement.

Researchers, in a Research Communication, **page 1354**, address this lacuna in knowledge by numerically evaluating the performance of a small group of reinforced stone columns – only a few centimetres in diameter – when embedded into soft clay. Thus, by analysing the performance of these miniature columns under stress, and hence ascertaining their physical parameters, such as their load bearing ratios, stress concentration factor, etc; researchers, in this study, evaluate the performance of reinforced stone columns as compared with the controls: ordinary stone columns.

Estimating soil organic carbon loss

A certain global disaster is taking birth right under our noses. Or to be more precise, under our very feet: Soil erosion.

ONE variable in particular makes the soil most vital to anthropogenic needs: the soil organic carbon, SOC. It takes tens of thousands of years for nature to sequester the carbon from plant and animal biomass into the few centimetres of top soil that quite literally feeds humankind's ambitions. But considering the unmitigated loss of SOC in recent years, owing to soil erosion, not only is the global agricultural production suffering, but also, in the near future, would lead to a massive increase in atmospheric CO_2. Not surprisingly therefore, researchers world over are tailoring soil management strategies to rein in the alarming rate of SOC loss.

But, obviously, before one can tailor a soil management strategy to check SOC loss, it is imperative that one has an quantitative estimate of *what is the rate of SOC loss*. To ascertain this figure, researchers first chart out an extensive soil map of a region of interest. In other words, researchers literally stroll through the area of interest, and bore shallow holes into the earth to sample soil. The sampling is repeated at equal intervals along the entire length and breadth of the area of interest. Once this soil map is charted, researchers then use *geostatistics* to 'guess' the rate of SOC loss.

Geostatistics – *geo*, meaning earth; *statistik*, data science – deals with the application of probabilistic models to spatial data points. Thus, given the data points from the field, and other environmental cues – rate of erosion, rate of soil formation, rainfall – it is possible, through geostatistics, to ascertain probabilistically the rate of SOC loss. But how accurate is geostatistics in its guess work? Is it reliable?

To answer this, a Research Article, **page 1326**, tests the efficacy of geostatistics as a tool to estimate SOC loss in a region that – owing to its undulating terrain, high rainfall, and humid climate – is particularly vulnerable to soil erosion: the northeast Indian state of Tripura.

Snow cover: a bird's eye view

THE Himalayan snow suckles many great rivers, such as the Ganges, that have today become the vital bloodline of the Indian existence. Millions of hectares of farmlands are irrigated by these rivers; great hydroelectric projects turn the turbine of trade and commerce; and hundreds of millions of people are directly dependent on these glacial – even sacred – waters for their survival.

So, it seems that the singular most important factor that ensures that these rivers are brimmed is the snow cover in the Himalaya. And any drastic decrease, or even increase in snow cover would inevitably result in catastrophic consequences. It is therefore imperative that researchers understand, in great detail, the temporal and spatial variability of the snow cover over the years. *Is the snow cover decreasing? Is it in on the rise? Which months witness peak snowfall? Which areas of the Himalaya receive most snow?*

But mapping and monitoring of seasonal snow cover of Himalaya – considering its harsh climate, and rugged topography – is a particularly challenging endeavour. In fact, conventional methods have time and time again failed to do so. A Research Communication, **page 1375**, however, has circumvented the topographic impediments of the Himalaya by 'eagle-eyeing' it. Indeed, this study analyses the data from satellites to map the snow cover – from 2004 to 2012 – over three Himalayan subbasins of the Ganges.

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